THURSDAY, FEBRUARY 25, 1897.

THE NATIONAL PHYSICAL LABORATORY.

THE case for the establishment of a National Physical Laboratory is very simple. The Kew Observatory began in a humble way, but became famous in the last generation for the work done there in connection with terrestrial magnetism. As the President of the Royal Society remarked, in his last annual address, the late Sir William Grove, more than thirty years ago, expressed the hope that Kew might become "an important national establishment." "And if so," he added, "while it will not, I trust, lose its character of a home of untrammelled physical research, it will have superadded some of the functions of the Meteorological Department of the Board of Trade, with a staff of skilful and experienced observers."

In the interval which has elapsed since Grove uttered these words Kew has advanced. It has become a considerable standardising institution. Including a large number of clinical thermometers, about 21,000 instruments are now examined there annually, and in spite of this commercial success, it still maintains its character as a home of physical research.

During the last ten years a similar institution has been established, on a much larger scale, at Charlottenburg. It is needless to describe the Reichsanstalt in these columns. It is sufficient to say that it is divided into two Departments—the one devoted to physical research, the other to technology. The work which the new Institution has done is very good, its reputation stands high, and after full consideration the chief scientific and technical Societies of this country decided to ask the Government to assist in placing Kew in a position to be similarly useful. A Committee was appointed, consisting of representatives of the Royal Society, of the British Association, of the Royal Society of Edinburgh, the Royal Irish Academy, of the Physical, Chemical and Astronomical Societies, and of the Institutions of Civil and Electrical Engineers. A memorial, prepared during the meeting of the British Association at Liverpool, was signed by a large number of representatives of science and industry. The request made to the Government suggested that the grant should be expended partly in improving the work of standardising, partly in promoting researches of a kind which cannot be undertaken by individuals or educational establishments. The terms in which this last request were made were almost a literal translation of those used in the memorandum in which von Helmholtz set forth the aims and objects of the Reichsanstalt. Lord Salisbury, however, entirely declined to accept this part of the programme, though he held out hopes that something might be done to help in the work of standardisation and verification. With this decision we do not quarrel. It is impossible for the Prime Minister to go beyond public opinion in such matters. We hope that the good work done at Kew may receive State aid, but the outburst in the *Times* of Saturday is sufficient to show that the innate tendency of the English people to distrust and reject all opinions based on special or expert knowledge is aroused by the terrible word "research." It is curious to observe in how many ways this tendency displays itself.

The official head of science in this country is a man on whom a peerage has just been conferred for an application of science to surgery by which thousands of lives have been saved. Lord Lister is also the head of an Institute for Preventive Medicine, which, if properly supported, would give to England all the benefits which are to be derived from the most modern methods of contending with infectious disease. The reward that he receives for these further efforts to benefit this curious Anglo-Saxon race is that a monster petition is presented to the Home Secretary against the licensing of the Institute for the performance of vivisection. If, therefore, a Pasteur Institute in London is anathema, we can hardly wonder if the gorge of the average Briton rises at the suggestion that there should be a Reichsanstalt at Kew.

The "splendid isolation," which we prefer to an alliance with either France or Germany, appears to include a rejection of their methods of avoiding rabies and correcting thermometers.

Some measure of the logical weakness of the opposition is, however, afforded by the misrepresentations of the *Times* article. The allegation that the memorandum attributed the loss of trade in thermometers to improvements in verification made abroad, is absolutely incorrect. The assertion that the Reichsanstalt and the proposed institution would be very different, is made in spite of the fact that the published descriptions of the work of the one, and of the proposed work of the other, are almost identical. Absolute ignorance was displayed as to the part which official science has played in the development of improved thermometers. For those who care for the reputation of a great journal, the article was painful reading. But it is needless here to describe or to defend the idea of a National Physical Laboratory, and we prefer to discuss another point on which we are glad to be at one with the *Times*. We agree that Germany beats us in scientific industries, not only because she fosters them, but because the examiner does not loom so large there as in this country.

It is, however, absurd to tell scientific men to remedy this. Who is responsible for the delay in making the University of London other than the mere college of examiners which at present it is? Almost every scientific man in London has done what he can to bring about that desirable consummation. The delay is due to those who claim to represent the views of the average Briton, as represented by the average passman of the University. Who is it that refuses to receive from candidates for scientific appointments in the Civil Service any evidence of scientific ability other than that which can be displayed in an examination? Not the Professors, but the State. It is a common experience of every teacher of advanced students, that he has to advise some member of his class as to whether he should undertake a piece of practical work or prepare for a particular examination. The teacher has no right to play fast and loose with the future of those who have placed their careers in his hands, and, even at the risk of being called a pedagogue, he is too often reluctantly obliged to confess that the future will be better

assured by success in the examination than by investigation. This is no fault of his. It is the fault of those who having once grasped the fact hat ability of a certain kind can be tested, without any suspicion of unfairness, by marks assigned by examiners to candidates whose names they do not know, insist on applying this test, and this test alone, in as many cases as possible, without inquiry as to whether the ability of the examination-room is the kind of ability for which they are in search, or whether other evidence could not be obtained, sifted and allowed to weigh in the final decision. It is the fault of the public, which regards the mystic letters B.A. or B.Sc. as an infallible test of the merits of a schoolmaster, but would not have a notion of the meaning of the words if he were described as the author of a memoir in the *Transactions* of the Royal Society. Nowhere is a more strenuous condemnation of the defects of the examination system found than among scientific investigators who are also examiners in science. It is, of course, impossible to change suddenly a method to which the public assign a value far above that which it deserves; but if teachers of science suggest any mitigation of its severity, they are at once told that they are seeking to fill their class-rooms with candidates for their patronage, and that they are trying to evade the only satisfactory test of the value of their teaching. Under these conditions they are helpless. It is not they, but those whose motives cannot be misrepresented as self-seeking, whose opinions cannot be misrepresented as biassed, who can loosen the fetters which English public opinion binds around the intelligence of English youth, and, unfortunately, the majority of such persons are convinced that the present system is the best.

We have followed the precedent set by the *Times* in passing from the proposal for the establishment of a National Physical Laboratory to the discussion of the examination system, for we agree that the rejection of the scheme for carrying out research in the one, and the general acceptance of the other, are alike indicative of the present temper of the English people on such questions. They do not believe that scientific ability is worth the cost of training and using it. They refuse to supply laboratories for advanced students, such as German students possess. They make the advancement of a middle-class youth depend entirely on his success in examinations. As represented by the London County Council, they appear to think that the best use to which they can put a Huxley, when they are fortunate enough to secure his services, is to set him to lecture to evening students.

They refuse to admit that there are certain conditions which must be fulfilled if the tasks of giving advanced instruction in science, and of advancing science, are to be carried out successfully, and then they turn and rend those who, in spite of these difficulties, have done something to advance both education and learning. Truly, history repeats itself.

"He said, Ye are idle, ye are idle. Go therefore now and work; for there shall no straw be given you, yet shall ye deliver the tale of bricks. And the children of Israel did see that they were in evil case."

RÖNTGEN RAYS AND CONSTITUTION OF GASES.

Röntgen Rays and Phenomena of the Anode and Kathode. By Edward P. Thompson, M.E., C.E.; with a concluding chapter by Prof. William A. Anthony. Pp. xiv + 190. (New York: Van Nostrand. London: Spon.)

The Constitution and Functions of Gases, the Nature of Radiance and the Law of Radiation. By Severinus J. Corrigan. Pp. viii + 127. (St. Paul: Pioneer Press Company, 1895.)

ALTHOUGH it is but a short time since Röntgen published his famous work on the X-rays, the very large number of scientific papers dealing with the subject, which have been published in all parts of the civilised world, makes the labour entailed in the production of a book of this kind very large.

Mr. Thompson, in his book on the X-rays, has endeavoured to give as complete an account as possible, not only of Röntgen's discovery, but of all the phenomena attending the passage of electrification through gases. With a view to make the subject intelligible to the lay mind, a short account is first given of induced currents and the discharge through gases at atmospheric and lower pressures. The author then passes to the consideration of the magnetic effects of the discharge, and the phenomena observed in the very high vacua of the Crookes' tube. A detailed description is given of Lenard's famous researches on the kathode rays, and of Röntgen's discovery of the X-rays and their properties. Considerable space is devoted to experiments dealing with the photographic developments and the use of the Röntgen rays in surgery. In the concluding chapter, Prof. Anthony sums up the results, and gives a short discussion on wave motion, without, however, venturing to suggest any explanation of the real nature and origin of the X-radiation.

A large number of X-ray photographs, or sciagraphs, as they are termed, are scattered throughout the volume, and some dust figures are also shown, a chapter being devoted to the description of them.

The author has adopted the method of dividing the book into numbered paragraphs, each of which is headed by the experiment to be explained, while references to the original publication are in nearly all cases given. The consequence of this is that the chapters consist of a detailed description of a number of experiments which are quite independent of one another; and as no attempt is made to criticise the results, or connect them together in any way, the result is somewhat confusing. The author, in many cases, lacks discrimination as to the relative importance which he assigns to the various experiments, and much of the earlier part of the book, notably the opening chapter, might be omitted with advantage.

The part of the book which deals with the X-rays, and the recent experiments on the subject, is much the best, and great praise is due to the author for the accurate *résumé* which has been given of nearly all recent work; and it is as a collected and condensed account of recent experimental work on the X-rays and allied phenomena that the book will be found most useful.

In "The Constitution and Functions of Gases," by Severinus J. Corrigan, an attempt has been made to advance a new dynamical theory of gases, and to do away with the necessity of a continuous ether for the transmission of radiation through space.

In the ordinary kinetic theory of gases, which has been worked out so fully by Maxwell, Clausius, and others, the molecules of which the gas is composed are conceived to be in continual motion among one another, each molecule moving through a mean free path, while pressure on a surface is due to the continuous bombardment of the molecules. The theory which Mr. Corrigan advances is as strictly dynamical as the ordinarily accepted one, but is based on quite different assumptions. The molecule, instead of being in continual motion to and fro, is at rest, but is made up of a large number of atoms, which revolve in orbits, approximately circular, round the centre of the molecule with enormous velocities.

The atoms themselves are supposed to be "perfectly elastic, incompressible, spherical solids which are arranged primarily in duads or combinations of two, and the atoms of each duad combination are mutually attracted by a force in each atom, which force, like that of gravity, varies inversely as the square of the distance between the members of the duad." These two atoms are endowed with opposite polarity of some kind, probably magnetic, and are analogous to a system of binary stars of equal mass and volume, and their motion is governed by the laws of motion of celestial bodies. The molecule is supposed to be built up of an enormous number of these rapidly rotating magnetic couples with the planes of their orbits in all directions, so that the molecule is a hollow shell of gas, the surface atoms of which are in extremely rapid motion round the centre of the molecule.

The pressure of the gas is assumed to be proportional to the mass of the gas and the angular velocity or vibration frequency of the atom, while a change of pressure alters the diameter of the atomic orbit. In a very rare gas, therefore, the diameter of the atomic orbit is immensely greater than at ordinary atmospheric pressure.

Proceeding on these assumptions, the author certainly makes his theory satisfactorily account for some of the properties of gases. Great stress is laid on the theoretical deduction, from the hypothesis, of a law of radiation of identically the same form as the empirical formula of Dulong and Petit. The value of the constant is also deduced, and this is in complete agreement with the experimental value.

The ether, instead of being the continuous medium demanded by physicists, is supposed to be molecular and discontinuous—practically a gas of excessive tenuity. A large amount of space is devoted to the consideration of a mode of transmission of radiation, from molecule to molecule of the gaseous ether, with the velocity of light; but so many difficult assumptions are made in the course of it, that the explanation, though plausible, is not at all satisfactory. The impulse which the revolving atom receives from contact with a vibrating surface is supposed to be handed on from molecule to molecule with the velocity of light; but it is not clear why an atom of an adjacent molecule should always be in exactly the right position for the transmission of an impulse.

It will be of interest to mention a few of the results which the author deduces from his equations. The number of atoms in the atmospheric molecule is calculated to be about 10^{14}, and the orbital velocity of the atom of air at atmospheric pressure and temperature ·500 million miles per second. The number of atoms per cubic centimetre of the gas agrees very nearly with the results deduced by Lord Kelvin and others. The density of the luminiferous ether (air = 1) is about $3 \cdot 10^{-16}$, and the diameter of a molecule of the ether ·002 inches.

As a consequence of the theory the conjugate atoms would be disrupted at an absolute temperature of 6679° Fahrenheit, and the author considers that disruptive electrical discharges, such as from an induction coil or in lightning, do break up the molecules, and it is the recombination of the dissociated atoms which causes the crash of thunder after the lightning flash.

The most unsatisfactory portion of the book is where the author endeavours to explain electrical phenomena, like atmospheric electricity, and natural disturbances, like tornadoes, by his theory of gases. A table of the dimensions and weights of the atoms of the molecules of the air and ether, which are deduced from the equations, is given; while a supplement is added to the book, deducing the same results in a different manner, and various theories are advanced in regard to the solar corona and astrophysics generally.

Though one may not agree with many of the author's assumptions, the fact remains that an interesting dynamical theory has been advanced which accounts for some phenomena not explained by any other theory; and for those who may be interested in speculations in regard to the nature and constitution of the gases and the ether, the book is well worth reading. E. R.

IMPRESSIONS OF OUT-DOOR NATURE.

A Year in the Fields. Selections from the writings of John Burroughs. With illustrations from photographs by Clifton Johnson. Pp. ix + 220. (London: Smith, Elder, and Co., 1896.)

A-Birding on a Bronco. By Florence A. Merriam. Illustrated. Pp. x + 226. (Boston and New York: Houghton, Mifflin, and Co., 1896.)

Summer Days for Winter Evenings. By J. H. Crawford, F.L.S. Illustrations by John Williamson. Pp. ix + 274. (London: John Macqueen, 1896.)

THE highest merit in any book of natural history is that it contains new and valuable information. Such books are often, but by no means inevitably, dry. Mr. A. R. Wallace may be named as one living writer who gives us new and valuable matter in a thoroughly readable form. Without being absolutely original, a book may yet be well worth writing if it contains a good deal of useful information served up in an attractive way. Then we come to the books which are attractive but not useful, and so to the books which are neither one nor the other.

None of the books before us belong to either the

highest or the lowest class. The naturalist may search them through without finding any passage which throws new light upon an important question. Perhaps we may, rather doubtfully, put "A Year in the Fields" among the books that both amuse and instruct. Mr. Burroughs is most agreeable to read, and now and then he tells us something that we are glad to know. But he sacrifices a little too much to the necessity of pleasing, and his books are impressions rather than studies. Miss Merriam and Mr. Crawford definitely belong to the class which amuses and does not instruct.

Mr. Burroughs has now found his public, and needs no lengthy notice at our hands. He writes as one who lives in daily contact with nature, occupying himself with her superficial aspects rather than with her problems. The reader of his books finds many pleasant pages, like the best descriptive passages of good novels, and occasionally a hint of some curious knowledge or reflection. Such a book as that before us (which, it is necessary to note, contains no new essays) is welcome to the naturalist in his less serious moods; it is genuine literature with a strong flavour of the woods and fields. The volume is illustrated by twenty photographs, of which all but one contain the author's figure in some favourite haunt. It is cheerful to think that he has now escaped from the public office, and is entering old age as a fruit-farmer on the Hudson.

Miss Merriam tells in a sprightly way her observations upon live birds in California. The Bronco is an old horse, from whose back she studied the birds with an opera-glass. The book is crowded with details, but they are hardly ever worth remembering; it relies upon its literary qualities, which are good, but not excellent. There are many illustrations, chiefly of nests or birds' heads.

Mr. Crawford's book is even thinner in substance than Miss Merriam's. A facile writer could come home after sitting for an hour in a garden-chair, or sauntering along a lane, and write such sketches as these almost without effort. They incline to the sermon in some places, to the novel in others. The very best remark in the book, from the naturalist's point of view, is this (p. 100): "The feet [of the lark] are adapted for running. They cover so many of the grass stems at once, that not only does the bird get along very much as one does on snow-shoes, but the elasticity of the pressed-down herbage aids in the spring." The illustrations have no natural history value. L. C. M.

OUR BOOK SHELF.

Guide pour le Soufflage du Verre. By Prof. H. Ebert. Translated from the second German edition, with notes by Prof. P. Lugol. Pp. 191. (Paris: Gauthier-Villars et Fils, 1897.)

THE utility and importance of even a small amount of knowledge in the art of blowing glass is perhaps best known to those who work in chemical, physical, and astrophysical laboratories. Tubes will crack, pumps will get broken, and many other similar mishaps will occur in the ordinary course of laboratory work. In such cases two remedies are available: either new apparatus must be bought, or it must be made. The former is doubtless the easiest, but the most expensive; while the latter is, in many cases, a saving of both time and money.

In England, Mr. Shenstone's little book on the methods of glass-blowing is the one which is most generally used. Prof. Ebert practically based his first edition on this admirable little treatise, embodying in it both his own observations and methods and those of others. The second edition, however, was considerably altered; in fact the book was practically reconstructed, as it was his intention to insert results of more recent experience, and give a strictly systematic course on glass-blowing.

The book before us is a French translation of this second edition, and it will be found to give full details to its readers how to make all the more common glass apparatus in use in laboratories, and how to mend those when broken. Prof. Ebert has adopted a logical sequence of the chapters, leading the glass-blower gradually by easy stages to the more difficult operations. The reader is first made to understand the mysteries of the blow-pipe itself. He is next given exercises which involve the training of the hands, first singly and then together. More difficult exercises are then put before him, from the construction of a trap to some complicated forms of vacuum tubes. In each lesson the necessary steps are clearly described, and in many cases illustrations are given showing the appearance of the apparatus at its several stages. This is an important point, for the great difficulty that a beginner meets with at first is not so much the actual making of the apparatus (which is acquired after a little practice), but a lack of knowledge of the various steps that have to be accomplished before the final stage is reached. For example, to make a large bulb in the middle of a tube, the beginner generally tries to blow the bulb directly without adopting the more easy stages of blowing three small bulbs close together, and amalgamating them into one large one.

The appendix contains some additional information which will be found useful to those working with glass, such as engraving on glass, the graduation of tubes, &c. Some further notes have also been added by the translator.

As a treatise on glass-blowing, Prof. Ebert's book can be thoroughly recommended, and those who are unable to master the German edition will find Prof. Lugol's translation an admirable substitute. W. J. S. L.

Projectiles de Campagne de Siège et de Place: Fusées. By E. Vallier. Pp. 178. (Paris: Gauthier-Villars.)

L'Éclairage. Éclairage aux gaz, aux huiles, aux acides, gras, &c. By Prof. Julien Lefèvre. Pp. 180. (Same publishers.)

Les Succédanés du Chiffon en Papeterie. By V. Urbain. Pp. 179. (Same publishers.)

THESE three volumes belong to the very practical series published under the editorship of M. Léauté, as the Encyclopédie scientifique des Aide-Mémoire.

M. Vallier confines himself to dealing with the projectiles from large guns. The first part of the book is concerned with field artillery (*projectiles de campagne*); the second with ordinary cast shells, shrapnels, and explosive shells (*projectiles de siège et de place*), and the third with fuses arranged to explode when the projectile collides, or at a given point of the trajectory. The volume is full of instructive information on the manufacture, properties, and mode of employment of different types of projectiles used in ordnance pieces.

In "L'Eclairage," Prof. Lefèvre first describes the principles of various systems of illumination, excluding electric lighting. He deals with the many processes involved in the production of gas from coal, and shows how gas is distributed. The many methods employed to burn gas most effectively are also described. Lighting by special gases, and by acetylene, form the subject of two other chapters. In a similar way lighting with candles,

vegetable oils, and mineral oils are dealt with, the processes of manufacture and purification, and the various kinds of lamps being described. A brief comparative statement of the prices and efficiency of different systems of lighting concludes the book.

The cellular substance of plants now used in the manufacture of paper, are known collectively as *succédanés des chiffons*. M. Urbain describes the different kinds of straw, Sparta grass, and wood used for this purpose; the physical and chemical constitution, so far as it is known, of cellulose; the manufacture of pulp from different cellular substances; and the methods of bleaching the paper. His book should be of use in showing how the structural elements of plants are now utilised in paper manufacture.

Alterations of Personality. By Alfred Binet. Translated by Helen Green Baldwin; with notes and a preface by Prof. J. Mark Baldwin. Pp. xii + 356. (London: Chapman and Hall, Ltd., 1896.)

M. BINET'S volume originally appeared in the "Bibliothèque Scientifique Internationale," and was reviewed in NATURE in July 1892 (vol. xlvi. p. 219). The subject with which it deals is beset with peculiar difficulties, and great caution is necessary before coming to any definite conclusions concerning the psychological phenomena involved; for though many observers have recorded strange alterations and modifications of personality, the cause of this spontaneous somnambulism is much disputed. M. Binet holds "that in a great many cases, and in very diverse conditions, the normal unity of consciousness is broken up, and several distinct consciousnesses are formed, each of which may have its own system of perceptions, its own memory, and even its own moral character." His book contains a detailed account of the results of researches by various psychologists on these alterations of personality. It is an authoritative statement of facts, and the translation, with Prof. Baldwin's notes, will be read with interest by the more intelligent section of the general public, as well as by the student of psychology.

The Hemiptera-Homoptera of the British Islands. By James Edwards, F.E.S. Pp. vi + 271. (London: L. Reeve and Co., 1896.)

STUDENTS of the insects of the Homopterous sub-order of the Hemiptera will find this volume very serviceable in the determination of their captures. The work is a descriptive catalogue of the families, genera, and species of the Cicadina and Psyllina indigenous to Great Britain and Ireland, with notes as to localities, habitats, &c. Particular attention is given to the consideration of characters which are of the greatest service in determining the several species and larger divisions of the insects described.

Analytical Keys to the Genera and Species of North American Mosses. By C. R. Barnes. Revised and extended by F. D. Heald. (Madison, Wis.: published by the University, 1897.)

ALTHOUGH a revision and extension of previous works by the same author, this is an important and valuable addition to the literature of bryology. It consists in the first place of a key to all the genera of Musci, including Sphagnaceæ, found in North America, and secondly of a similar key to all the species in each genus. Some idea of the labour involved will be gathered when it is stated that the genera number over 140; and that in some of the genera—*e.g. Sphagnum, Orthotrichum, Bryum, Hypnum*—there are from 50 to over 90 species. In a copious appendix is given a diagnosis of all the new species described between 1884 and 1896.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Dynamical Units.

MANY of the writers of letters on this subject seem to have forgotten that the question Prof. Perry raised was as to the best system of units to use with a class of *engineering students*. This question is very seriously complicated by the fact that all their books, and almost all their teachers, use a system of units which is *not* that of the poundal, but is essentially the one that Prof. Perry advocates. This is a very serious fact that every teacher of engineering students must take account of, and the question is, "What system shall the teacher use with engineering classes?" I entirely agree with Prof. Perry in thinking that it is much better for the teacher to accommodate himself to the requirements of his class than for him to force his class to use one system when working for him, and another outside his class-rooms. This latter plan tends to perpetuate the prevalent notion that science has nothing to do with practice.

As regards the question of why students find dynamics and the notion of mass in particular so difficult, I do not believe that this is due to any difficulties about various systems of units. In matters upon which their ideas are clear and distinct, such as length and time, the existence of different units, feet, yards, miles, &c., minutes, days, &c., presents very little difficulty. To British students these varieties of units in which to measure the same quantity are so familiar, that they naturally look upon varieties of units with contempt. It is only when the thing measured is not clearly and distinctly conceived, that confusion and all sorts of difficulties arise. Hence the importance of getting students actually to come into contact with the things themselves. Until a student has some ideas of density, acceleration, &c., as things to be measured, he will be quite certain to misapply the rules he has learnt for dealing with the black marks he makes on a piece of paper, and which he calls by their names. Now of all these dynamical quantities, of which students are generally expected to form clear and distinct ideas without any actual experience of the things themselves, the most abstruse, and the one about which the most metaphysical statements are made, is "quantity of matter" or "mass." *À priori*, there is no way by which we can determine whether a quantity of gold is equal to a quantity of iron. In ordinary practice there are two kinds of equality which are commonly used: volume and weight. If I tell any ordinary man to mix equal quantities of whisky and water, he will mix equal volumes. It is quite as common to mean equal volumes as equal weights by equal quantities in common language. When a student is told, as an *explanation* of the word "mass," that it means "quantity of matter," there is an appeal made from the obscure to the more obscure. It is a case of huggermugger. The student thinks the teacher must have some clear and distinct idea of what he means by "quantity of matter," and is ashamed to say that to him it is no explanation of mass to call it "quantity of matter." Thus begins the demoralisation of the student. He is demoralised by having to swallow undigested a term of which neither he nor his teacher has a clear and distinct idea, and he naturally concludes that the whole subject is one that "no fellow can understand."

If teachers and books would give up this metaphysical notion of "quantity of matter," and would deign to confine their attentions to actually measurable quantities, like volume, weight, and inertia, the student could be given, by making experiments, clear and distinct ideas of these properties of matter as actual quantities to be measured. Once he had these clear and distinct ideas, a variety of units for measuring each of them would not present any serious difficulty. That the inertia of matter is proportional to its weight, that the inertia of a body is the same here as in the moon and Jupiter—these are most important physical facts to be proved by experiment, because we have no other way of ascertaining them. It is often *assumed* that the inertia of a hot body is the same as of the same body when cold; but I do not know of any accurate experiments having ever been made to prove it, and I am quite certain that a great deal too little is known of the structure of matter, and of its relations with the ether, to be able to prove *à priori* that the inertias are the same. The suggestion would probably involve the further suggestion

that we could make a machine to utilise some of the energy in the ether; but does any one profess to know so much of that remarkable thing as to be quite certain that this is impossible? Any way, there is no doubt that to a considerable degree of accuracy inertia *is* a constant property of a body, and equal inertias may consequently be very reasonably considered as equality of such a very important property of two bodies, that scientific people are justified in their shortly describing the bodies as equal, which is what they usually do, and is all that they can really mean when they speak of equal quantities of iron and gold. Why, then, trouble unfortunate students with the idea that there is some huggermugger metaphysical "quantity of matter" called "mass," of which they are supposed to have a clear and definite conception distinct from this equality of inertia? Why not call it inertia when it is inertia that is meant, and drop out of use that word "mass," round which such a tissue of indistinct and obscure ideas have grown, that it is almost hopeless to separate it from them.

I hope some word more euphonious than "slug" will be found for the unit of inertia on the engineer's system. I would suggest "ert" as a term that would easily recall the quantity inertia. GEO. FRAS. FITZGERALD.

Trinity College, Dublin, February 10.

The Flight of Gulls in the Wake of Steamers.

MANY persons have remarked the extraordinary power displayed by gulls of keeping pace with a steamer without any motion of their wings. A few days ago, I had a good opportunity of observing this during a voyage from Alexandria to Marseilles.

When the wind was blowing at right angles to the course of the vessel, having first gained some slight elevation, the gulls would glide downwards with expanded wings, making, during the descent, rapid progress in the same direction as the steamer. When quite near the water they would suddenly turn and face the wind, at the same time giving their bodies an upward incline, and the wind would lift them to their former elevation, after which the process would begin again. A wind blowing horizontally has the power of lifting, only because each stratum, so to speak, of air moves more rapidly than the stratum immediately below it. Consequently, as the bird rises, it has the inertia due to the fact that it has just emerged from the slower current below. Thus it may be compared to a kite, the inertia taking the place of the string. When gulls progress in this way, at right angles to the wind, the vessel does not in any way assist them, and, occasionally, when they are not following a steamer, they may be seen employing the same method.

With a head-wind they advance with even greater ease. To understand how this is possible, some investigation of the air-currents behind the ship's stern is necessary. If small pieces of paper are thrown overboard when a strong head-wind is blowing, they are seized by a tremendous down-draught, but, some few yards astern, they suddenly dart up again. In fact, as the vessel moves onward, the air rushes down to fill the vacuum, then rebounds off the surface of the sea, and forms an up-current. Placing himself in this up-current, the gull is lifted as if he were no heavier than a scrap of paper, then he glides downward and onward. But as the vessel moves on, the up-current advances, or, strictly speaking, the point at which the up-current is formed. At the end of his descent the gull finds himself in this, is again lifted, and the process is repeated.

When the wind was not a due head-wind, but struck the vessel at a slight angle, now and then a gull would be seen apparently hovering motionless over the stern, of course really gliding onward with the vessel. Though I cannot speak with confidence of the explanation of this, the most wonderful of the methods employed, I wish to put forward what seems the probable explanation. The wind striking against the side of the vessel is deflected upwards, and it is this up-current which buoys up the gull as he floats over the stern. Though it may appear that his progress is perfectly uniform, I think it will be found that in advancing he descends slightly, that he often loses ground for a time, and that while losing ground he ascends. Thus the method in this case is really the same as in that last described. Unfortunately, I was not able to prove the existence of this up-current about 20 feet above the stern of the vessel. But there is good evidence of it in the fact that the gull remains suspended there without a motion of his wings. Without an up-current this would be an impossibility. It is to be hoped that good observers will give their attention to these very interesting phenomena. F. W. HEADLEY.

Haileybury, February 8.

Two Unfelt Earthquakes.

ON February 7, commencing at about 8 a.m., G.M.T., an unusually large, but, at the same time, unfelt earthquake was recorded in the Isle of Wight. The preliminary tremors, which include three well-defined maxima, extended over twenty-six minutes. After these came two periods of heavy movement, each extending over fifteen or twenty minutes. The duration of the whole disturbance was about one and one-half hours. It was Japanese in character, and because it was recorded in Tochia by Dr. G. Grablovitz, and at the same time was so marked in amplitude and duration, it is not unlikely that it disturbed the entire surface of the globe.

On the 13th there was a comparatively small disturbance, with preliminary tremors of three or four minutes, at about 10 a.m. I should be pleased to learn whether these earthquakes were recorded by bifilar pendulums in Edinburgh or Birmingham, or at any of our magnetic observatories. JOHN MILNE.

Shide, Newport, I.W., February 18.

FOUNDATIONS OF CORAL ATOLLS.

THE most regrettable failure of the boring lately attempted in the coral atoll of Funafuti has left us as wise as we were as to the actual structure of these formations; but the surveys carried on by H.M.S. *Penguin*, both at Funafuti and in the regions round about, have afforded information which, I think, is of value in elucidating some of the problems to be solved, and which has certainly strengthened some of my own views on the subject.

Funafuti, it may be mentioned, was selected for investigation as being one of a great Pacific group of atolls, which must have a common great cause for the formation of their necessary foundations, and for their development; groups which had a great share in causing Mr. Darwin to conclude, from the lack of other explanation of banks in large numbers at a proper depth for the growth of an atoll, that subsidence on a large scale was the predominant agent in their production ("Coral Reefs," 2nd ed., pp. 118, 119; 3rd ed., pp. 120, 121.)

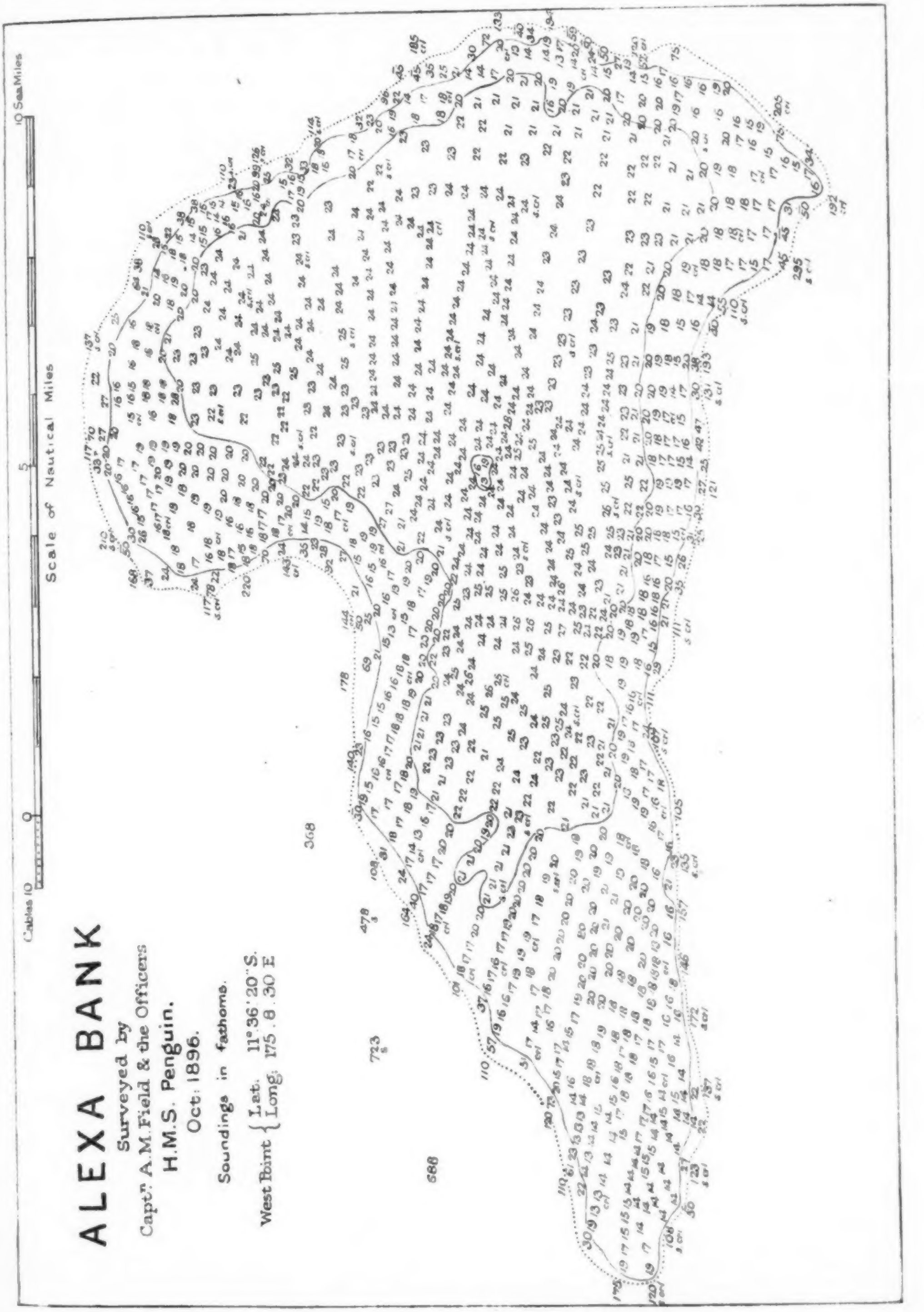
Firstly, the sounding carried on by the *Penguin* round Funafuti and between separate islands of the Ellice Group, show incontestably that each atoll is situated on a separate mound, rising from a more or less even bottom of great depth below the surface. This proves that there has never been anything of the nature of a range of continental land which has gradually sunk beneath the waves. Each atoll, if it has sunk, has subsided independently, with its own isolated volcanic peak.

Secondly, the *Penguin*, while searching the seas some 250 miles to the south-westward of the Ellice Islands for several reported dangers to navigation, explored four banks, all of submerged atoll form, lying near one another.

The remarkable thing about these banks is the absolute uniformity of the depth of water over their areas, inside the low rim of growing coral which encircles their edges in various degree. This depth is 24 to 26 fathoms. The banks are large: one is 22 miles by 10; another is 18 miles by 9; the third is 8 by 7; and the fourth 4 by 3. The plan of one of them is given on the next page as an example.

Another bank, investigated a few years ago by H.M.S. *Waterwitch*, and lying 400 miles to the eastward, presents similar characteristics, and the same depth over its central area. All these banks are situated in a region exposed to the same conditions of wind and sea.

What causes this remarkable similarity of depth and this extraordinarily even surface over these large banks? Is


ALEXA BANK
Surveyed by
Captn. A.M. Field & the Officers
H.M.S. Penguin.
Oct: 1896.
Soundings in fathoms.
West Point { Lat. 11°36'20" S. Long. 175.8.30 E
Scale of Nautical Miles
Cables 10
0
5
10 Sea Miles

it uniform subsidence of mounds, of identical height, over a great area? Is it building up of mounds to an identical distance below the surface? I cannot think that either can account for the conditions. I would venture to suggest the cutting down of volcanic islands by the action of the sea, and that this operation has a far greater share in furnishing coral foundations than has generally been admitted.

The operation has not been overlooked. Mr. J. Murray says: "Volcanic mountains . . . like Graham Island, might be wholly swept away, and only a bank with a few fathoms of water over it be left on the spot. In this way numerous foundations may have been prepared for . . . even atolls" (*Proc. Roy. Soc. Edin.*, vol. x. p. 507). Sir A. Geikie, in referring to Murray's views, says, "those portions of volcanic mountains that rise above the sea-level are worn down by the atmosphere and waves, and unless otherwise preserved, must eventually be reduced to the lower limit of effective wave-action, which is probably nearly coincident with the lower limits of reef builders."

I can find, however, but little further reference to it, and prominence has not been given to it as a principal cause, as has been given to, on the one hand, subsidence, or, on the other, the building up of mounds by organisms other than corals.

Darwin specially rejects it. He says ("Coral Reefs," 2nd ed., p. 124): "It will probably occur to those who have read Ehrenberg's account of the reefs of the Red Sea, that many points in these great areas may have been elevated, but that, as soon as raised, the protuberant parts were cut off by the destroying action of the waves: a moment's reflection, however, on the basin-like form of the atolls, will show that this is impossible; for the upheaval and subsequent abrasion of an island would leave a flat disc, which might become coated with coral, but not a deeply concave surface; moreover, we should expect to see, at least in some parts, the rock of the foundation brought to the surface."

Let us now consider the general condition of the material piled up by a submarine volcano.

I find that David Forbes (*Geol. Mag.*, 1870, p. 323) is of opinion that erupted lava meeting water will assume the form of scoriæ, tufa, ash, and similar loose and subdivided matter, and I believe that many other geologists will agree. Instances of recently-formed volcanic islands add testimony to the correctness of this view. Graham Island, near Sicily, was all ash, and quickly disappeared. The new island in the basin of Santorin, formed in 1866, is all ash, as I know from personal investigation. Falcon Island, near the Tonga Group, which appeared in 1885, is all ash, and is now reduced to a small proportion of its original dimensions. Sabrina Island, on the flank of St. Miguel in the Azores, was formed in 1811, all of loose material, and was washed away to a depth of 15 fathoms in a short time. What water is now over it is not known.

No doubt when an ash mound has assumed sufficient dimensions to resist the percolation of water, the lava will be poured out in a mass and solidify, and form a mountainous island of the familiar oceanic type; but it appears to me that all the evidence goes to show that an enormous proportion of the material ejected by a submarine volcano will be loose, until a great height above the sea is attained.

If this be granted, here is an easy material for the sea to work upon. The next point is, to what depth does the action of the sea attain?

To those unacquainted with the ocean it may seem incredible that it can be in motion sufficiently violent to, at depths of 50 and 60 fathoms, move material; but I think that there is good evidence of it.

An isolated rock exposed to the full strength of the sea from one of the great oceans will cause a heavy breaker on the surface, when it is submerged as much as 10 fathoms. Let us think for a moment what this means, and what the horizontal velocity of the water at the depth of the rock must be to cause such a disturbance at the surface.

All who have studied the submarine contours of the land exposed to the great oceans, will know the remarkable fact that there is in the great majority of cases a sudden steeper fall at the depth of from 80 to 100 fathoms. This can only be explained on the supposition that the material eroded from the coasts can be moved and distributed to that depth.

The depth at which matter can be moved will, of course, vary with its size and tenacity. It is sufficient for my purpose if it is only fine mud and sand which is acted upon at such a depth as 80 fathoms, although submarine cables have been taken up which show evidence of having been moved and chafed at even greater depths.

Cables have been recovered which show that breakage has occurred from their being moved in 260 fathoms, and, by the kindness of Mr. F. Lucas, I have in my own possession a steel wire forming part of the outer covering of the Brazilian cable, picked up from 140 fathoms, which is worn down on one side as with a file. The records of the Cable Companies can furnish numerous similar instances.

While there are, as might be expected, banks in the oceans of every conceivable depth, there are a very large number with a depth over them, which is to my mind conformable to the depth to which wave action extends.

I may instance the great bank on which the Seychelles Islands stand. This is roughly 16,000 square miles in area, and has a general depth over it of 30 fathoms, though it is not so absolutely flat as banks less gigantic.

In the course of recent hydrographical operations it has been gradually borne in upon my mind that banks at great depth can reveal themselves upon the surface. Numerous instances have occurred where, on search being made for the cause of reported "breakers," deep banks, some lying as far below the surface as 800 fathoms, have been found on the spot, but nothing shoaler could be detected. "Rips" have, however, been seen in the course of the search, and steered for in the expectation that shallow water existed, but to no purpose. In such cases it seems probable that it is the tide (which extends to the bottom of the sea) meeting the obstacle of the bank, which is accelerated to such an extent that it affects the surface.

I have, therefore, no difficulty in believing that volcanic ash can be moved at depths of 30 fathoms, or more, when exposed to the action of waves in an otherwise deep sea, over which strong winds are continually blowing.

The effect will be to cut down an island more or less rapidly, according to its constitution, to a very considerable depth below the surface; the final result being a perfectly flat bank.

Mr. Darwin, as above quoted, speaks of a flat bank as unrepresentative of the floor of an atoll; but I think that this was a consequence of the comparatively small amount of facts at his disposal.

I have no hesitation in saying that a flat floor is an invariable characteristic of a large atoll, and I cannot find his "deeply concave surface" in any large atoll. On the contrary, a flat surface is found in all of these, whether the rim be above or below the surface.

It is true that towards the sides of a lagoon the depth gradually lessens; the encircling rim is not so steep as it is on the outside, but I think this is only what would be expected from the less vigorous growth of coral on the inner side of the rim as it rises, and from the gradual dissemination of débris from the rim thrown over by the waves.

I fail to see how subsidence of a solid peak, or the elevation of a submerged peak by the growth of

organisms, will explain a flat floor, without bringing in the action of the sea at considerable depths. In a subsiding peak with a barrier reef, there cannot be sufficient wave-action to level a large lagoon. In a bank rising by growth, why should it become level over its whole surface?

A further point remains. Can coral settling on a bank, 30 fathoms or so beneath the surface, form an atoll? Mr. Darwin limits this possibility to "some fathoms submerged," and considers that "it is an assumption without any evidence that at a depth at which the waves do not break, the coral grows more vigorously on the edges of a bank than on its central part."

I think that the experience of the years since Mr. Darwin wrote that, has given us evidence that this is not an unwarrantable assumption.

The instances of shallow narrow rims, or of isolated patches of coral on the edges of such banks, are now innumerable.

It is so well recognised that the edge of such a bank is the place to expect shoal patches, that in carrying out hydrographic surveys in coral regions it is the edge that is most minutely searched. On such edges are found evidence of coral colonies in every stage; complete ridges, broken ridges, and mere patches here and there.

Always, where means have permitted, is evidence brought up that such colonies are alive. There may be dead rims, but they are the exception.

The fact of a current, whether tidal, or otherwise induced, being accelerated on meeting a submarine bank is, I think, sufficient to account for this. The water pours over the edge of the bank, and brings abundance of food to those corals which settle on it, to the disadvantage of those settling further in.

The phenomena of coral patches and ridges on the edge of these submerged banks is so frequent, that I know not how they can be otherwise explained. The great Seychelles Bank is lined all round its edge, so far as examined, with such coral ridges and patches. The small islands, in this case of primary rock, in the centre of this bank are lined with fringing reefs; and if the whole bank, 150 miles in length, has uniformly sunk, they must have sunk too, and the fringing reefs would be beneath the surface.

Given these edgings of vigorous living coral on submerged banks, of which I consider we have indisputable proof, they will certainly grow to the surface and form the complete atoll. In the earlier stages calcareous organisms of all kinds will settle all over the bank, giving it a coating more or less thick according to circumstances.

The only other point that need be mentioned is the steep slope that characterises some atolls. As to this, I believe that masses with irregular projections like broken coral, falling down in water, will entangle themselves, and lie at a steepness of slope unknown in similar falls on mountain sides, and though the aid of subsidence may be needed for the almost vertical walls which occasionally occur, that the slopes of most atolls can be explained without it.

There seems no necessity to call in the aid of Murray's theory of deepening and widening of the lagoon by solution, but I am not contending that it may not so act. What I am concerned to show is that without it, and without subsidence, deep and large atolls may be formed, and that we have abundant evidence of atolls so forming.

I am not arguing that there has been no subsidence; indeed, I think that a volcanic cone, from the nature of its loose material, will frequently subside, and that some of the deeper lagoons may owe their depths of 50 fathoms or so to such a movement, quite apart from subsidence of large areas which we know occurs. Nor do I say that volcanic mounds that have failed to reach the surface, may not be built up to a sufficient height for corals to flourish; nor that all foundations and atolls have been formed in the same way; but I put forward the hypothesis that the cutting down of volcanic islands by wave-action and currents, has had a greater share in providing suitable bases for coral atolls than any other process of nature.

I may further suggest, in defence of my views, that it tends to explain why, over vast groups of atolls, no central summit is left. W. J. L. WHARTON.

FRIDTJOF NANSEN'S "FARTHEST NORTH."[1]

WHEN Gerrit de Veer published his "True and perfect description" of Barents' voyages for the discovery of a North-east passage, "so strange and woonderfull that the like hath never been heard of before," he justified himself for doing so by several reasons:—

"And also to stoppe their mouthes, that report and say, that our proceeding therein was wholly unprofitable and fruitelesse; which peradventure in time to come, may turn unto our great profite and commoditie. For he which proceedeth and continueth in a thing that seemeth to be impossible, is not to be discommended; but hee, that in regarde that the thing seemeth to be impossible, doth not proceed therein, but by his faint-heartedness and sloath, wholly leaveth it off."

This might not inappropriately be taken as an apology for Nansen's popular account of his great Arctic journey, which in many ways finds its nearest prototype in the classic adventures of the Dutch explorers three hundred years ago, when the lifting of a ship on the ice without being nipped was first observed, and the nature and effects of ice-pressures were first clearly described. For an example of a Norse Arctic explorer visiting England and receiving a Royal welcome, we must go back a thousand years to the time when King Alfred entertained Othar, and gave in a gloss on his Orosius the first record of Arctic discovery ever written in the language of the English. But between the visits of Othar and Nansen the progress of Arctic discovery has been due mainly to our countrymen, who have purchased with their lives much of the experience on which the safe and successful voyage of the *Fram* was planned.

These large and handsome volumes, giving the full narrative of the voyage, have been very rapidly prepared, too rapidly for the careful reader, who has been sacrificed to allow the eager public to revel in a story of adventure. More leisurely preparation might have left the book no less readable, and made it much more valuable, by including at least a few preliminary reports on the results of the voyage which must necessarily be of "great profite and commoditie" in many branches of knowledge. The revision of the text might have been more complete, the cumbrous title-page might have assumed a pleasing form, there might have been a prefatory note acknowledging the author's debt to the translators, whose work certainly deserves recognition, and the maps might have been of a less provisional character. Scientific readers will, however, be content to await the full discussions by specialists, which are doubtless in preparation, and meantime they cannot dip into the narrative of the most successful of all Arctic voyages without becoming absorbed by its peculiar fascination. The glamour of the Arctic regions has been felt by almost every explorer, and not a few have succeeded in passing it on to the readers of their books, but none so perfectly as Dr. Nansen. Too often the tale

[1] Fridtjof Nansen's "Farthest North," being the Record of a Voyage of Exploration of the Ship *Fram*, 1893-96, and of a Fifteen Months' Sleigh Journey by Dr. Nansen and Lieut. Johansen. With an appendix by Otto Sverdrup, Captain of the *Fram*; 120 full-page and numerous text illustrations, 16 coloured plates in facsimile from Dr. Nansen's own sketches, etched portrait, photogravures and maps. 2 vols. Pp. 1200. (Westminster: Archibald Constable and Co., 1897.)

of human suffering, and the tragedies of the retreat towards relief expeditions which have missed their mark, darken the records of Arctic travel. But here there is no tragedy. The necessary killing of the sledge-dogs to support the life of the rest is the harshest feature, and that seems to have seriously disturbed the equanimity of the kind-hearted explorers. To any but hardened sportsmen the pathetic display of maternal and filial affection between polar bears or walruses and their young, brings the cruelty of hunting man into painful relief; but happy, indeed, is that Arctic expedition in which sympathy for suffering is enlisted on behalf of the lower animals alone.

The pictorial power of Nansen's descriptions of the Arctic night, or the mysterious solitudes of the ice-fields, need not be dwelt on here, nor shall we linger on the psychological aspect of the expedition, the alternations of hope and doubt, the reminiscences of home as familiar anniversaries came round again and again, but proceed rather to point out some of the practical deductions to be made from the voyage. The preliminary scientific results having been already referred to in NATURE (vol. lv. p. 352), need not be repeated; but it is interesting to compare the actual experiences, detailed in the book,

[*Copyright by Archibald Constable and Co.*, 1897.

FIG. 1.—Cleaning the Accumulators before stowing away.

with the original project as described in the *Geographical Journal* (vol. i., 1893, p. 1) and summarised in NATURE (vol. xlvii. p. 65).

The ship answered the purpose for which she was designed exactly. The rudder was unshipped through the rudder-well, and kept on board during the greater part of the drift; but it was not found necessary to unship the propeller, which sustained no damage from the ice. Despite the great strength of the ship, and the wonderful freedom from strain, even during the severest ice-pressure, a good deal of water found its way on board during the summer months, but the leakage was found quite insignificant when the ship was floated after her three years on the ice. The lifting of the vessel by ice-pressure took place exactly as predicted, and she lay on the ice on a nearly even keel almost all the time, recovering her position spontaneously after being heeled over by heavy pressures. The non-conducting walls of the saloon entirely obviated the bugbear of all former expeditions—the condensation of moisture on the roof and sides, which, running down, saturates the cushions and bedding. With the fire lighted, the saloon was perfectly dry, and so warm that the fire was usually dispensed with. The arrangement for the supply of light was not quite so satisfactory. The engine was taken to pieces when the *Fram* was fairly beset, and the dynamos were worked for the first two years by a windmill, which gave good results. Early in the third winter the windmill wore out, and Sverdrup took it down; the accumulators were cleaned (see Fig. 1) and packed away. The men on board had so much necessary work to do with observations, shifting the boats and emergency stores, which were always kept on the ice, and had to be closely watched on account of the appearance of cracks, that there was no time to work the dynamo by means of a capstan and multiplying gear, as originally planned, and so for the longest and darkest winter of all there was no electric light.

The health throughout seems to have been perfect. The weight of all the members of the expedition increased. We read of Nansen suffering from lumbago for a day or two, of Sverdrup being laid up once with intestinal catarrh attributed to a chill, of a few slight frost-bites, a little snow-blindness, but nothing worse. There was no threatening of scurvy, and the doctor had no professional work to do beyond weighing himself and his companions, and counting the red blood-corpuscles once a month. All the food taken proved perfectly satisfactory, except some pemmican prepared with cocoanut fat, which even the dogs declined after once trying it. In every particular the equipment and provisions of the expedition were in excess of the actual requirements, and nothing not taken, except a long sounding-line, seems to have been wanted. Dr. Nansen attributes the good spirits and harmony of the expedition largely to the fact that all thirteen members lived together, eating the same food at the same table, and sharing the same work; he was much gratified with the complete success of this novel social experiment.

The *Fram* left Vardö on July 21, 1893, embarked a number of Siberian sledge-dogs at Khabarova, and entering the Kara Sea on August 4, coasted along the north of Asia, discovering many new island groups, and encountering no serious difficulty until September 25, when in latitude 79°, north of the Lena Delta, she was frozen into the ice-floe and commenced her drift. The first two months were spent drifting in various directions, but mainly south-east. Then a change occurred, and a north-westerly drift set in very slowly and irregularly, with many diversions to southward, while the ice under the *Fram* steadily increased in thickness.

On February 2, 1894, the crossing of 80° N. was celebrated; on May 15 81°, on October 31 82°, and on December 25 83° were successively attained. On January 6, 1895, the *Fram* was further north (83° 34′) than any previous expedition had reached, and it was a year and a half before she returned again to recorded latitudes. March 3 brought her to 84°, due north of Cape Chelyuskin, and on September 22 she crossed 85°, going north-west. For four months she remained north of 85°, and the sun remained invisible below the horizon for five and a half months—from October 8, 1895, to March 24, 1896. This was the longest and darkest winter ever experienced by man; but Sverdrup, in his record of it, makes light of its tedium, and notices no decline in the general health of himself and his ten comrades. On November 15, 1895, the northward component of the westerly drift ceased to act in latitude 85° 55′, longitude 66° 31′ E., and from that date there was a southerly component, increasing until the drift was due south in April. On May 19, 1896, steam was got up for the first time, and the fight to escape from the ice-floe commenced. Sverdrup blasted the vessel free, and worked her slowly through the lanes, as they appeared in the breaking pack, for 180 miles, at length reaching the open sea and sighting

the north-west point of Spitzbergen on August 13, 1896, after having been for 1041 days out of sight of land.

While the *Fram* was tracing out her intended path in comparative tranquillity the originator of the expedition, with one companion, was engaged on a far more adventurous journey. Nansen and Johansen left the comfort and plenty of their safe quarters on board on March 14, 1895, and pushed northward over the hummocky ice with dog-sledges carrying kayaks, until April 4, when the failure of the dogs made it necessary to turn in 86° 14', N., nearly 200 miles beyond any former seeker of the pole. No land was seen, only an interminable floe. By May 19 they were back at 83° 20', and but for the misfortune of allowing their watches to run down, and so losing their longitude, they would in all probability have reached Spitzbergen in the autumn of 1895. It was the one error of the expedition, and it was heavily paid for, for it involved the dismal wintering in a miserable hut on "Frederick Jackson's Island," living on bear and walrus meat from August 26, 1895, to May 19, 1896. A month's journey southwards in the spring brought them to Mr. Jackson's headquarters at Cape Flora, whence they sailed in the *Windward* on August 7, and returned safely to Vardö on the 13th.

The more one thinks over the details of this expedition the more remarkable does it appear. The strong current which Nansen believed to cross the polar area was not indeed found quite as he expected it, but there was an average drift due to prevailing winds in the predicted direction and of the predicted velocity. No land whatever was encountered, but a sea nearly two thousand fathoms deep. The resourcefulness of the leader is shown in his making a long sounding-line from one of his wire cables which was untwisted for the purpose in a ropewalk extemporised on the ice. The deep sea was fortunate, for the danger of a vessel being nipped and crushed is always greatest when the floating ice is driven against a resisting shore. Possibly the *Fram* would have resisted any pressure, for even in the severest trial to which she was subjected, when the advancing pressure-mound rose high on the rigging and the noise of the crashing ice was louder than thunder, she did not sustain the slightest damage. The photograph reproduced in Fig. 2 shows the crew of the *Fram* cutting away the pressure-mound of ice that had been hurled against one side of the vessel.

Little as either Nansen or Sverdrup makes of the dangers, and cheerily as their comrades bore themselves throughout, no one reading this book can fail to feel the profoundest respect and admiration for every one of them; and the public of this country has testified this to Nansen by a reception such as no scientific man or traveller has received before. This is a tribute to the calm and unswerving pursuit of an idea based on sound reasoning, and carried into effect by the highest personal qualities of courage, faithfulness and brotherly kindness.

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FIG. 2.—Digging out the *Fram*, March 1895.

Many points invite special notice, such as the interesting descriptions of the formation of pressure-mounds (hummocks) and cracks in the ice, even during the coldest weather. The occasional spells of high temperature in winter are suggestive of föhn effects; but these will, of course, be duly discussed in the scientific report. One very extraordinary phenomenon, known as "dead water," was noticed in the Kara Sea, and we hope that such observations were made at the time as will enable its true nature to be discovered. It is described (vol. i. p. 174) as a layer of fresh water which is carried along by the ship, slipping over the surface of the salt water below, and retarding the progress of the vessel. How a steamer with the propeller working in strong sea water can fail to cut through a superficial layer of fresh water, is very difficult to understand.

HUGH ROBERT MILL.

THE DISCOVERY OF ANOTHER CONNECTING LINK BETWEEN FLOWERING AND FLOWERLESS PLANTS.

NEWS has recently reached Europe, from Japan, of a botanical discovery of unusual interest and importance. Two investigators, Prof. Ikeno (*Botan. Centrabl.*, 1897, 1) and Dr. Hirase (*ibid.*, 2 and 3), working independently, have observed the formation of antherozoids—bodies which have hitherto been regarded as exclusively confined to flowerless plants—in two groups of gymnosperms.

It is well known that in a large number of cryptogams, including all the higher forms, the process of fertilisation is intimately connected with the presence of water. The spores (or, at any rate, certain of them) give rise on germinating, sooner or later to cells from which free-swimming antherozoids are liberated. Each of the latter consists of a loosely coiled nucleus ensheathed in protoplasm, which is especially abundant at the anterior end of the body, and from it arise the cilia which enable the antherozoid to move through water.

In the flowering plants, on the other hand, with their special adaptations to a terrestrial mode of existence, it is of obvious disadvantage to depend on the precarious presence of water as the means of enabling the male sexual cell to find the female, and we find that the motile antherozoids are replaced by quiescent male cells, which are conducted to the female organs along a tube—the pollen-tube—which is a direct outgrowth of the spore or pollen-grain.

Now the gymnosperms, whilst they share with the rest of the flowering plants many characters in common, including the possession of a pollen-tube, yet differ from them in other important respects and approximate more nearly to the higher cryptogams. It is to the brilliant work of Hofmeister, more than forty years ago, that the recognition of this fact is primarily due, and it is, perhaps, a matter for surprise that a group occupying such an admittedly important position should not have been long ago subjected to a more searching scrutiny than it has received. It is true that Strasburger has added much to our knowledge; but, perhaps, the first really illuminating discovery since Hofmeister's time was that made by Belajeff in 1891, which was confirmed and extended by Strasburger in the following year. It was there shown that, whereas the similarity between the female prothallium and its products with the corresponding structures in cryptogams had already been recognised, a closer investigation into the process of germination of the pollen-grain also yielded quite unlooked-for resemblances to the homologous stages in the lower plants, clearly confirming the near kinship of the two groups.

But the presence of a pollen-tube, which would seem to render the formation of antherozoids superfluous, if not indeed directly disadvantageous, still appeared as one of the sharply-drawn distinctions between the zoidogamous cryptogam and the siphonogamous phanerogam. It is in the successful bridging over of this gulf that the great importance of the new discovery lies.

The two gymnosperms, *Cycas revoluta* and *Gingko biloba*, in which antherozoids have just been found, are both ancient types, and closely resemble each other in the mode of the formation of their male sexual cells. At first the pollen germinates much as in the other higher plants, forming a pollen-tube which penetrates the ovule, and containing a group of cells from one of which the antherozoids are ultimately derived. But unlike other forms which have been thoroughly investigated, the pollen-tube remains short, and although it may branch, it does not reach the archegonia in which the female cells are contained. The archegonia themselves lie round the base of a depression situated at the apex of the prothallium, and the space above them is stated to contain a watery fluid. The two generative cells, which have travelled to the end of the rudimentary pollen-tube, now become differentiated into antherozoids. The nucleus, which is large and egg-shaped, lies enclosed in protoplasm, and the latter alone supplies the material for the formation of the coiled anterior portion of the body. Cilia are formed on the coil in great numbers, and are able to impart a progressive, rotatory motion to the antherozoid. Dr. Hirase, who studied their behaviour in *Gingko* while alive, was able to watch them actually moving, and probably the same is true of Cycas, although, owing to the material having been killed, this, of course, could not be tested in the case of the latter plant. They are large bodies, measuring about $82\mu \times 49\mu$, and escape from the end of the pollen-tube, reaching the necks of the archegonia by swimming through the intervening water.

In reading the short account, as yet published, there is a point of especial interest which strikes one, namely, that the plant must have already begun to eliminate the element of risk which a dependence on a mere chance supply of water entails, by itself secreting the liquid necessary to enable the antherozoid to accomplish its mission. As soon as this habit has been developed it becomes intelligible how, in these more primitive examples, the spore might proceed to swell and finally put out a protuberance on the side nearest the water-supply. And the more effectively this was carried through, the less would be the chance of missing fertilisation Thus it becomes comparatively easy to reconstruct, at any rate theoretically, the transitional stages between zoidogamy and siphonogamy. J. B. F.

HUMAN INCUBATORS.

IN a recent number of *L'Illustration* an account is given of an incubator used for rearing delicate children. The apparatus designed by Dr. Tarnier, Professor of the Faculté de Paris, was first used, in the year 1880, at the Paris Maternity Hospital: it is constructed on the same principles as the incubator used for hatching the eggs of poultry.

The apparatus, as first designed, consists of a large cubical box of thick wood, standing on a pedestal. This box is divided into two compartments, of which the lower contains a reservoir of hot water, and the upper the bed of the infant. A movable glass shutter forms the top of the apparatus, through which it is possible to observe the changes occurring inside, and take the readings of the thermometer placed near the infant. One side of the compartment is so hinged as to open like a door. The whole of the upper part is warmed by means of the hot water underneath, the warm air rising through holes at each end of the bed, and escaping through orifices situated at the top. The temperature of the water is so regulated that the temperature of the apparatus never exceeds 30° to 37° Centigrade. The weaker the infant is, the greater the temperature required.

Dr. Tarnier, with the help of his house surgeon, M. Auvard, lost no time in improving this apparatus. His latest design does not differ very much from the one described above; it has, however, the advantage of being more simple in character, and also lighter in construction. (Fig. 1.) The external dimensions measure 65 × 30 × 50 centimetres, the thickness of sides being about 25 millimetres. The upper part of the case is divided into two sections, one being a wooden fixture, L, about 13 centimetres wide, and having a circular opening 4 centimetres in diameter at its middle part, to which may be attached a small helix, H. The rotation of this helix indicates the existence of a draught of air through the case. The other section is a glass shutter, V, which also serves as door.

The interior of the case is divided into a lower and

upper compartment by means of a shelf, D, extending almost across. The circulation of the air is as follows: air from the outside penetrates into the lower compartment through an opening, T, in the side; it acquires there a suitable temperature from the heaters, M,

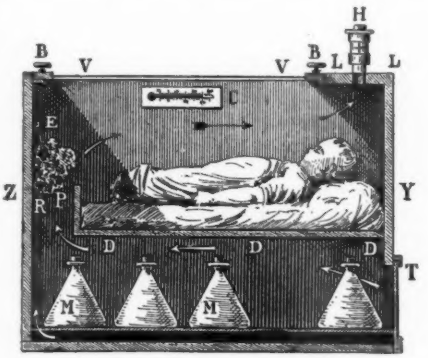

FIG. 1.—Dr. Tarnier's New Apparatus.

and rises into the upper compartment, moisture being obtained by its passage through a wet sponge, E. These heaters are capable of holding three-quarters of a pint of water. Five of these can be used at one time in the apparatus; but four are found sufficient to maintain the required temperature of 31° to 32°, provided the room is not less than 16°.

The infant is generally kept in the incubator from seven to fourteen days. This is about the *average* time, but it varies considerably, and cases have been known when the period has been extended to five weeks. The child may be taken from the incubator every two hours to be fed; but it must only be exposed to the air as short a time as possible, and care must be taken that the room is of a suitable temperature.

It is of interest to notice the decrease of mortality. The usual percentage of deaths of infants under 2000 grammes is 66 per cent., but by the use of the incubator this high figure is reduced to 36 per cent. Of those children born prematurely, few only survive; whereas it is now possible to save about 45 per cent.

While great care is taken to help to maintain the heat of the body of the child, it is also necessary to allow its system to renew that heat. If, therefore, the child is not strong enough to take food, some means must be taken of injecting it. In this case a probe, consisting of an india-rubber tube, with a graduated glass funnel at the end, is used. This instrument is inserted in the mouth, and pushed gently down the throat, and going a distance of fifteen centimetres, reaches the stomach. The probe is pressed, and sends the milk into the funnel until a sufficient quantity has been administered, when it is rapidly removed to prevent the return of the fluid.

Judging from the accounts which have been published, the improved apparatus seems to be very successful.

NOTES

THE following remarks, abridged from an editorial in the February number of the *American Naturalist*, will be cordially supported by many men of science on this side of the Atlantic:—"While the primary object of the university is instruction, there are several reasons why original research is of more than incidental importance to its prosperity. The mastery of his subject, which is characteristic of the man who advances the knowledge of it, is an essential of a good teacher. The belief in this truth is so general, that the teacher who is known as a discoverer will more successfully attract students to his classes than he who is not so known. But, apart from this, the general reputation of a school before the public is more surely affected by the research work that issues from its faculty, than the managing bodies of some of them seem willing to admit. We believe that those universities which permit of the production of original work by those of its professors who have proven themselves competent for it, are wise above those who do not do so. Those who load such men with teaching, so as to forbid such work, reduce their prosperity. The managers will be wise to preserve for these men sufficient leisure to enable them to advance the frontiers of the known, and thus to obtain juster views of things as they are, and to bring us ever nearer to a comprehension of the great laws, whose expressions it is their business to teach to the growing intelligences of the nation."

THE Société Industrielle du Nord de la France has awarded a gold medal to M. Moissan, in recognition of his scientific investigations.

THE Council of the Sanitary Institute have accepted an invitation from the City Council of Leeds, to hold a Sanitary Congress and Health Exhibition in that city in the month of September next.

ACTING under the provisions of a rule which empowers the annual election by the Committee of nine persons "of distinguished eminence in science, literature, the arts, or for public services," the Committee of the Athenæum Club have elected Dr. David Ferrier, F.R.S., Professor of Neuro-pathology at King's College, London, a member of the Club.

THE Council of the Society of Arts attended at Marlborough House on Tuesday, February 16, when his Royal Highness the Prince of Wales, K.G., President of the Society, presented the Albert Medal to Prof. David Edward Hughes, F.R.S., "in recognition of the services he has rendered to arts, manufactures, and commerce, by his numerous inventions in electricity and magnetism, especially the printing telegraph and the microphone."

THE new building for the South African Museum at Capetown has now been completed, and fitted with the so called "Dresden cases," which are made entirely of glass and iron, and are believed to be absolutely dust-proof and air-tight. Under the superintendence of Mr. W. L. Sclater, the Director, the collections are in process of removal from their former quarters into the new building, which is expected to be opened to the public by March 1.

WE regret to record the following deaths of men of science abroad:—Dr. Timothée Rothen, Director of the International Telegraph Bureau at Berne, and author of numerous treatises on telegraphy and telephony.—Prof. Karl Theodor Weierstrass, Professor of Mathematics in the University of Berlin, and Foreign Member of the Royal Society.—Prof. M. Klimm, Professor of Hydraulics in the Polytechnikum at Budapest.

REFERRING to Mr. Evans's letter in last week's NATURE, upon immunity from stings of bees, Mr. T. A. Gerald Strickland sends us a note on a similar case. A bee-keeper, having accidentally upset a hive, was so badly stung that he was laid up for a few weeks, but afterwards the stings of the bees did not affect him, though before his involuntary inoculation they caused great pain and swelling. The accident happened some years ago, but the bee-keeper was still indifferent to stings last autumn.

THE Royal Academy of Belgium has awarded gold medals, of value 600 francs, to Dr. C. De Bruyne, of Ghent, for his essay on the influence of phagocytes in the development of the Invertebrata; to M. G. Cesàro, of Trooz (Liège), for his essay on Belgian minerals; to MM. J. F. Heymans and O. Van der Stricht, of Ghent, for their conjoint paper on the peripheric nervous system of *Amphioxus*; and to M. Jean Massart, for his essay on the cicatrisation of plants.

The prosperous *Société de l'Industrie Minérale* of Saint-Etienne invites original communications from its members on mining, metallurgy and mechanics, for which the Council will award premiums varying from 500 to 1000 francs. The subjects to be dealt with are: in the mining section, the working of thick coal seams, and underground haulage by compressed air or electric locomotives; in the metallurgical section, the methods for removing dust from combustible gases, the manufacture of open-hearth steel, and the utilisation of the waste heat of furnaces for steam boilers; and, in the mechanical section, the use of high pressure, cut-off gears, compounding and condensation in winding engines, and the employment of superheating in steam engines. The papers must be written in, or translated into, French, and must be in the Secretary's hands by December 31, 1897.

THE international aerostatic ascents, which for some time past have been contemplated, took place on the 18th inst. at Paris, Berlin, and Strasburg. Three unmanned balloons were liberated at about 10 a.m. (local time) at each station. The German Emperor witnessed the Berlin operations, but the balloon burst. The Strasburg balloon disappeared in the north-east, and has not yet been recovered. The Paris balloon descended, after having travelled during a little more than two hours in the N.N. ¼ E., and ran 102 kilometres. The temperature recorded was 60°, at an altitude of more than 10,000 metres. An apparatus, constructed by Cailletet, for bringing back to land the air of the upper atmosphere, was successful, but the gas captured has not yet been analysed. The records are confused to some extent, but the balloons and instruments are safe.

MR. ALEXANDER WHYTE gives an interesting description of his travels in North Nyasa, in the *British Central Africa Gazette*, published at Zomba. Mr. Whyte stayed at Karonga for a short time, and then went through Napata to Chifungu's village, where he obtained some interesting specimens; among others, a fine oriole and a tiny little chestnut-backed owl, neither of which he had previously met; also a pretty little squirrel, only one of which he had previously collected. The botany of the neighbouring hills and valleys he found most interesting. Journeying from Chifungu's village, the hills became higher and only sparsely clad with stunted forest, short grass, and weird-looking deformed shrubs. One looked like a miniature four-foot baobab, afflicted with elephantiasis, the soft smooth-barked branches being abnormally thick and suddenly tapering to a sharp point. All the rocky ridges had a species of Velozia upon them. This species was similar in habit to the new one (*V. splendens*) discovered by Mr. Whyte on the Mlanje range, but the branches form a more acute angle with the stem, and it is believed to be another species. Near the Wyie River some interesting birds were collected; among others, a bright little kingfisher very similar to *Cayx tridactylus* of India and Ceylon. Following the Wyie River the grand Nyika range was eventually approached, and, after a stiff climb, the plateau of the range was reached. Towards the end of last November, Mr. Whyte was collecting zoological and botancal specimens on the top of Mlosa mountain and plateau. He eports that he has procured some interesting specimens, several of which he thinks are new to science. The top of Mlosa plateau consists of rolling hills covered with fine short grass, well-wooded in the gullies, and with a plentiful supply of water. The plateau is not quite equal in extent to the Zomba plateau, but lies at about the same elevation (between five and six thousand feet above the sea), and the scenery is even finer than that of Zomba. Access is obtained to the Mlosa plateau by more easy gradients than the Zomba plateau or that of Mlanje.

THE Gold Coast, Ashanti, and Kumassi, is the subject of an illustrated article, by Mr. George K. French, in the *National Geographic Magazine* for January. Mr. French journeyed from Cape Coast Castle to Kumassi, through Prahsu, or the Prah River, and the Adansai country, and his descriptions of the natives, as well as his photographs, are very instructive. It is satisfactory to see the expression of an opinion that "England's enlightened policy in other parts of Africa will undoubtedly be applied here, and will result in the ultimate spread of civilisation throughout this darkest part of the dark continent."

THE fourth number of the current volume of the *Mittheilungen von Forschungsreisenden und Gelehrten aus den deutschen Schutzgebieten* contains a number of notes of geographical and meteorological importance. An abstract is given of the results of several hundred boiling-point determinations made by Dr. Stuhlman and First-Lieut. Schlobach in Usaramo, Ukami, and Uluguru, during 1894-5: reduced with more intelligent care than is usually bestowed on such data Lieut. Merker contributes a note, with sketch map, of two new lakes between Kilimandjaro and Meru. Further abstracts of meteorological observations at three stations in Konde—Manow, Wangemannshöhe, and Ikombe—are given, and also at Jaluit, in the Marshall Archipelago.

THE *Board of Trade Journal* makes the following announcements:—An Exhibition will be held at Bergen in Norway in 1898, to consist of an International Fisheries Section and of national sections for industries, agriculture, and fine arts. The grounds of the Nygård Park (Nygårdsparken) have been selected as the site of the Exhibition.—A Transmississippi and International Exhibition will be held at the City of Omaha, in the Stat of Nebraska, in the year 1898, for the exhibition of the resources of the United States of America, and the progress and civilisation of the Western Hemisphere, and for a display of the arts, industries, manufactures, and products of the soil, mine, and sea.—The Parliament of New South Wales has decided to hold an International Exhibition at Sydney in 1899. According to statements made in the House, the cost of the Exhibition will be 250,000*l.*, and the Australian products shown thereat will be sent to Paris in 1900.

THE connection between relative humidity and the manufacfacture of cotton fabrics, is probably too slender to be seen by the "practical man" in Great Britain, or to need any consideration from a practical British Government. In the United States, however, there are Government departments which frequently make inquiries into the bearings of natural phenomena upon industry. A few days ago we received a "Report on the Relative Humidity of Southern New England and other Localities," prepared under the direction of Mr. Willis L. Moore, Chief of the U.S. Weather Bureau, by Mr. Alfred J. Henry. Upon the face of it, one would hardly expect more than meteorological statistics and conclusions from this *Bulletin*. But mark how the facts work out. One of the conditions essential to the greatest degree of success in the spinning and weaving of cotton fabrics is a humid state of the atmosphere, and the more constant the degree of humidity the greater is the measure of profitable spinning, especially as regards the finer numbers. The average

spinning of England is finer than that of the United States, and the average of the latter varies greatly with geographical location, the finer spinning being done almost wholly in New England. The attention of the Weather Bureau having been called to the importance of the subject and to the probable extension of the manufacture of cotton over a much wider area than it has yet occupied, a comparison was instituted with a view of ascertaining how the natural humidity of certain portions of the United States, particularly the South, where the extension of the art is most pronounced, compares with that of the southern shore of New England. It is with the results of the investigation made in this connection that the *Bulletin* deals, and we have no doubt that the observations and conclusions from them will be used to advance cotton manufacture in the United States. The idea that the tendency to concentrate the cotton manufacturing industry in Lancashire was originally due to the advantage of climatic conditions, is, of course, not entertained. Indeed, it appears from the report that thus far in the development of the cotton manufacturing industry too little account has been taken of climatic conditions as affecting the quantity or quality of the output. For the benefit of enterprising cotton manufacturers the suggestion is made that the control of both temperature and humidity by artificial means seems to be the final solution of the problem in all cases where the establishment of mills in a relatively dry district is contemplated.

WE are pleased to notice a marked improvement in the first number of the new volume of the *Rivista Scientifico Industriale*, published in Florence. The editor and founder, Dr. Guido Vimercati, has now the co-operation of Dr. Carlo del Lungo. The most noteworthy feature of the present number is a complete bibliography of all Italian works relating to Röntgen rays published in 1896. It is the intention of the editors to deal with other branches of physics in the same manner in subsequent issues. The number is accompanied by excellent stereoscopic figures of an optical bench for interference experiments, illustrating a paper by Prof. G. Grattarola.

DR. G. TOLOMEI, writing in the same journal, describes an interesting series of experiments on the presence of argon in plants. The author inferred the absence of argon in fully-developed vegetable tissues. Experiments were also made with the nodule-forming Leguminosæ, and with their nitrifying bacteria, and the results were the opposite of that just cited. In the case of nitrogen obtained from the growing roots of a young pea, argon was obtained from the tissues, but in smaller quantities than from the culture of bacteria; and hence the author maintains that the argon fixed by the bacteria does not enter into chemical combination, on the ground that if it did so, it would, if once absorbed, remain in the plant instead of disappearing in the older tissues.

PROF. W. SOMERVILLE has carried out a series of comparative experiments to test the value of the pure cultures of the various varieties of bacteria that inhabit the roots of our more important Papilionaceous plants, now sold under the name of "nitragen." The investigation was described before the Botanical Society of Edinburgh on January 14. Experiments were made with peas, broad beans, lucerne, and broad red clover. Only in the case of the peas did the application of nitragen result in an increase in the yield, and even then the variations in the weights of produce were too small to make it possible to say definitely that the inoculating substance affected growth either one way or another. The experiments were carried out in a garden attached to the Durham College of Science, in which it may be assumed that peas and beans have frequently been cultivated during recent years. As the soil was thus well supplied with the bacteria that associate with the roots of these plants, Prof. Somerville agrees that it is not surprising that the application of a pure culture of these bacteria should have been inoperative. But as regards red clover and lucerne, neither of these plants has ever been cultivated in the garden, and the probability is that not a single plant of lucerne ever grew in the garden, or, indeed, in any fields in the neighbourhood. The conditions, therefore, were to be regarded as distinctly favourable for exhibiting the action of the specific bacteria of these plants, and yet they failed to produce any effect. Apparently some improvements are required in the methods of manufacture or application in order to make nitragen of service in agriculture and horticulture.

THE influence of intellectual work on the blood-pressure in man is the subject of a paper, by MM. A. Binet and N. Vaschide, in the January number of the *Psychological Review*. The instrument used by the authors was Mosso's Sphygmomanometer, which has the advantage of indicating the results by tracings. The method of experimentation consisted in taking the pulse under increasing pressure from 0 to 140 mm. of mercury: this test was made at first while the subject was in a state of rest, without excitement or preoccupation of any kind; then the same experiment was repeated while the subject was absorbed in a difficult mental calculation. Two tracings were thus obtained for comparison, and the differences between them could be attributed to the intellectual labour, unless some chance circumstance—as an emotion, a shiver, &c.—prevented the two experiments from being strictly comparable. From the results obtained, it appears that the maximum amplitude of the pulsation tracings was greater during rest than during intellectual work; it was 5 mm. in the former case, and only 3·5 mm. in the latter. During all the mental calculations, there was evidently a diminution of the pulse, as the result of a more or less marked vascular constriction. In both states, the maximum amplitude of the pulse appears to have been reached when the blood-pressure was 80 mm. Beyond this pressure, the amplitude decreased more rapidly during the state of rest than during mental activity, and a pressure of from 100 to 120 mm. was found to completely suppress the pulsation both in a state of repose and in a state of intellectual labour. To determine the difference between the circulation in a state of intellectual labour and that of rest, a counter-pressure of 110 mm. was chosen. A register of the pulse with this pressure was made for about half a minute, and then the subject was told to commence a mental calculation. The first three or four pulsations after he was told to begin were of the same character as the preceding ones, but afterwards the pulsations became twice and, often, three times as great. This increase in amplitude maintained itself, in general, without increase or diminution, and with great regularity during the whole of the mental calculation. When the problem had been solved, the pulsation gradually diminished, and finally reached the original condition.

THE fourth part of vol. ii. of "Fresenius' Quantitative Analysis," translated by Mr. Chas. E. Groves, F.R.S., has just been published by Messrs. J. and A. Churchill.

THE following are the arrangements for science lectures at the Royal Victoria Hall, Waterloo Road, during March:—March 2, "A Lump of Salt," by Prof. Holland Crompton; March 9, "Cyprus," by Mr. A. H. Smith; March 16, "The Valley of Kashmir," by Mr. Walter R. Lawrence; March 23, "Marine Food Fishes," by Mr. Gilbert C. Bourne; March 30, "Quicksilver," by Dr. H. Forster Morley.

THE *Boletin del Instituto Geológico de México*, by Dr. C. Sapper, describes the geology and physical geography of Yucatan. It includes chapters on the mineral and agricultural productions of the peninsula, and meteorological tables.

THE fifth volume of the *Journal of Malacology*, founded by Mr. Walter E. Collinge, and now edited by Mr. Wilfred Mark Webb, has been received. A valuable feature of each number is a descriptive bibliography of current malacological literature, compiled by Mr. E. R. Sykes and Mr. S. Pace.

THE *Bulletin de l'Herbier Boissier*, edited by Prof. Chodat, of Geneva, publishes a very interesting account, by the Belgian botanist Crépin and MM. Autran and Durand, of the plants cultivated by Boissier in 1885, the year of his death, in the gardens at Valleyres and Chambésy. The number of species enumerated is nearly 5000.

WE have received an important excerpt from the sixteenth annual report of the U.S. Geological Survey (1894-95). The subject is "Some Analogies in the Lower Cretaceous of Europe and America," and the author, Mr. Lester Ward. Mr. Ward devoted four years to a somewhat careful study of the Lower Cretaceous of America, especially of the Potomac formation; and he also spent a year or so in examining the structure of Portland, the Isle of Wight, and other typical localities. His own observations, and the work done by others, lead him to claim that certain general resemblances do exist between the Lower Cretaceous strata of America and those of Europe.

L. LORENZ's "Œuvres Scientifiques," with notes by H. Valentiner, are being published at the expense of the Carlsberg Foundation. The first part of the first volume has just been issued by the firm of Lehmann and Stage, Copenhagen. It contains papers on the determination of the direction of vibrations of ether by polarisation of diffracted light, and also by reflection and refraction; on the reflection of light at the separating surface of two transparent isotropic substances; on the theory of light (two memoirs); and on the identity of the vibrations of light and electricity. The editor's notes on the papers are very full.

IN the years 1889, 1892, and 1896, Prof. Carl Rabl contributed three important memoirs on the "Theorie des Mesoderms" to the *Morphologisches Jahrbuch*. These papers have now been brought together and published in volume form, under the same title, by Wilhelm Engelmann, of Leipzig. The volume deals with the development and differentiation of the mesoderm, a subject to which Prof. Rabl has devoted much attention. To complete the work, a second volume, dealing with the differentiation of the mesoderm in the higher vertebrates, from amphibia upwards, will be published in the course of this year. We propose to review this important contribution to vertebrate morphology when it is completed, and content ourselves now with announcing the publication of the first volume.

THE scheme which the late Emperor of Russia set on foot for constructing a canal through Russia from the Baltic to the Black Sea, and which has been in abeyance since his death, has lately been revived. M. Flourens, the French Minister for Foreign Affairs, who in his private capacity was commissioned by Alexander III. to investigate the practicability of constructing a water-way for the passage of men-of-war from one sea to the other, has recently been to St. Petersburg, and had a conference with the present Emperor, and has been directed to consult the Ministers of Finance and Communication as to its practicability. The proposed canal would be 994 miles long, and would have a depth of 29 feet. It would start from the Gulf of Riga, follow the course of the Duna, the Beresina, and the Dnieper to the Black Sea, thus placing the naval dockyards of Libau in the north and Nikolaief in the south in direct communication. The estimated cost is £20,000,000. There is at the present time a navigation for small vessels and timber rafts along this route, but the way is interrupted by a long series of cataracts on the Dnieper, and very expensive works would have to be carried out to overcome these and the other obstacle in the way.

THE following lectures will be given at the Imperial Institute during the month of March, on Monday evenings, at 8.30 p.m.:—March 1, "Ceylon in Ancient and Modern Times," by Mr. H. W. Cave; March 8, "Imperial Aid to Solar Research, with an account of recent Eclipse Expeditions," by Mr. J. Norman Lockyer, C.B., F.R.S.; March 15, "Some Indian Dye-stuffs," by Prof. J. J. Hummel; March 22, "The Timber Supply of the British Empire," by Dr. W. Schlich, Professor of Forestry at the Royal Indian Engineering College, Cooper's Hill. In addition to these lectures, which are open to Fellows and persons introduced by them, a popular lecture, to which the public will have free admission, will be given at 8 o'clock p.m. on March 2, on "Queensland of to-day: some Notes on its Progress and Resources," by Mr. C. S. Dicken, C.M.G., Acting Agent-General for Queensland.

INTEREST in science is encouraged by the scientific societies connected with many of our public schools. The twenty-seventh annual report of the Wellington College Natural Science Society shows that varied and instructive meetings were held during 1896. Phenological observations were made, meteorological observations continuously recorded, and collectors of insects, plants, shells and eggs, showed enthusiasm in collecting and in determining species. The late Sir John Pender left a bequest in his will to permanently establish the Pender Prize, annually given by the Society for an essay on a subject connected with any branch of science. Preference is given to essays containing original work of any kind. Prizes of this kind are far more likely to create investigators, and thus extend a knowledge of the true inwardness of nature, than are prizes based upon the results of examinations.

THE tenth annual report of the Liverpool Marine Biology Committee and their Biological Station at Port Erin, by Prof. W. A. Herdman, F.R.S., is an excellent record of results. The large green *Thalassema*, of which several specimens, all more or less mutilated, were trawled from the deep water to the southwest of Port Erin at Easter, seems to be an undescribed form. Prof. Sherrington and Dr. Noël Paton have independently investigated the green pigment spectroscopically. They report that it is a very remarkable and apparently unknown pigment, which is not allied to hæmoglobin or chlorophyll. It is not a respiratory pigment, and is apparently nearer to "bonellein," described by Dr. Sorby from the Gephyrean *Bonellia viridis*, than to any other known pigment; but differs markedly in some respects, and cannot be identical with it. This is only one of the many interesting items in Prof. Herdman's report on work accomplished under the auspices of his Committee.

PROF. S. P. LANGLEY's report on the operations of the Smithsonian Institution for the year ending with June 1896, has just been distributed. As has been already announced, the Institution has now completed its first half-century of existence. To commemorate this event, arrangements have been made for the publication of a memorial volume, which will give an account of the Institution, its history, its achievements, and its present condition. The volume will be a royal octavo of about 750 pages. It has been prepared under the general editorship of the late Dr. Goode, and will be found as worthy of the Institution as was every other task entrusted to his hands. The division is into two parts: one on the history of the Institution, and the other containing appreciations of the work of the Institution in different departments of science, written by various

men of science in the United States. The Institution has renewed for three years the lease of the Smithsonian table at the Naples Zoological Station. The table has been constantly occupied since October 1, 1893, the date of the first appointment, with the exception of May 1894. During the intervals of his official duties, Prof. Langley has continued to experiment with the aërodrome, until he has reached a measure of success which, he announces, justifies him in making the statement that mechanical flight has now been attained. On May 6 last, a mechanism, built chiefly of steel and driven by a steam engine, made two flights, each of over half a mile (see NATURE, vol. liv. p. 80). Since then Prof. Langley says this result has been doubled. In the astrophysical observatory Prof. Langley has continued his researches upon the solar spectrum. The results of the year's work are summed up by the statement that an entirely new stage of accuracy has been reached by the elimination of sources of error, of long standing, in the spectro-bolometric processes, and that as a result of this accuracy it is expected that the positions of between 200 and 300 lines in the infra-red spectrum will shortly be published.

BY his further investigation of the reversible decomposition of hydriodic acid gas, published in the February number of the *Zeitschrift für physikalische Chemie*, Mr. Max Bodenstein removes all doubt as to the normal character of this change, thus adding another to the very small number of reactions between gases which are known to follow the laws of mass action. In a former investigation he had found that, at a given temperature, the fraction of the hydriodic acid decomposed when equilibrium was attained was not independent of the pressure of the gas. Since the decomposition takes place without change of volume, theory indicates that, at constant temperature, the equilibrium should be unaffected by a change of pressure. This discrepancy is removed by the experiments described in the present paper. Known quantities of hydrogen and iodine are heated in sealed glass bulbs at a constant temperature until equilibrium is attained, whereupon the quantities of hydrogen, iodine, and hydriodic acid present are determined. This leads to the, at first sight, somewhat surprising result that equivalent quantities of hydrogen and iodine have disappeared. In one experiment neither hydriodic acid nor iodine were found in the heated bulb, the whole of the iodine used having disappeared. The cause of this loss is found in the combination of hydriodic acid with the glass; part of the iodine is found as sodium iodide; the greater part, however, appears to form some compound insoluble in water. When the diminution in the concentration of the hydriodic acid gas, to which the combination of part of it with the glass gives rise, is taken into account, it is found, in accordance with theory, that the fraction of the hydriodic acid decomposed, at constant temperature, when equilibrium has been reached, is independent of the pressure.

IN a second paper, on the decomposition of hydriodic acid gas by sunlight, it is found that on prolonged exposure the whole of the hydriodic acid is decomposed; the change is thus not reversible. The intensity of the light remaining constant, the quantity decomposed in unit time is simply proportional to the quantity of undecomposed hydriodic acid present, and is not affected by its pressure (within the limits 0·5 and 1 atmosphere approximately). These are the characteristics of a monomolecular reaction, and it therefore follows that each molecule of hydriodic acid is decomposed independently, each ray of light, of proper vibration frequency, simply breaking up the hydriodic acid molecules in its path.

THE addition to the Zoological Society's Gardens during the past week include a Green Monkey (*Cercopithecus callitrichus*, ♂) from West Africa, presented by Mr. John Laxson; a Rhesus Monkey (*Macacus rhesus*, ♀) from India, presented by Mr. W. H. Camm; a Grey Lemur (*Hapalemur griseus*) from Madagascar, presented by Mr. W. B. Dyer; a Greater Vasa Parrot (*Coracopsis vasa*) from Madagascar, presented by Surgeon Lieut.-Colonel F. H. Gelbresa; an Upland Goose (*Chloephaga magellanica*, ♂) from the Falkland Islands, deposited; five Azara's Opossums (*Didelphys azaræ*), ten Burrowing Owls (*Speotyto cunicularia*) from South America, eight Guira Cuckoos (*Guira piririgua*) from Para, two Uvæan Parrakeets (*Nymphicus uvæensis*) from the Island of Uvea, Loyalty Group, a Smew (*Mergus albellus*, ♀) from Holland, purchased.

OUR ASTRONOMICAL COLUMN.

PERIODICAL COMETS.—The present year seems to be somewhat barren of appearances of periodical comets, while, on the other hand, the two following years will be distinguished by the returns of several well-known comets.

This year's visitors are limited to three altogether, namely, 1890 VII., D'Arrest's, and Swift's. The first named seems, from all accounts (*Observatory*, No. 249), to be most probably very feeble in intensity, since at its appearance in 1890 it was an excessively faint object. The comet was described by Dr. Spitaler at Vienna, and a computation showed that it had a period of 6·4 years, so that it should make its perihelion passage on March 11. Those who wish to search for this comet will find an ephemeris in *Astr. Nach.*, No. 3370.

D'Arrest's comet, discovered at Leipsic in June of the year 1851, has also a period of nearly the same length, namely, 6·5 years. This comet has not been observed at every period, having been seen only in the years 1857, 1870, 1877, 1890. It is probable that even this year it will be missed, in consequence of its unfavourable position. A daily search ephemeris (March to August) for this year will be found to be given by M. G. Leveau in the *Bulletin Astronomique* for last month (January).

Swift's comet will not be seen, owing to the fact that it will be lost in the sun's rays, as the earth will be in the opposite part of her orbit to that nearest the comet at perihelion passage.

A comet that may be picked up again this year is Brooks' 1886 IV., and observations of this comet are wanted, as the period is not yet accurately determined.

A list of the comets which are due to appear in the next two years is quite a formidable one, as given by Mr. W. F. Denning in the current number of the *Observatory*:—

1898.		Comet.	1899.		Comet.
April	...	Pons-Winnecke.	Jan.	...	Denning (1881 V.).
May	...	Encke.	Mar.	...	Tempel (1886 I.).
June	...	Swift (1889 VI.).	April	...	Barnard (1892 V.).
June	..	Wolf.	May	...	Tuttle (1858 I.).
Sept.	...	Tempel (1867 II.).	May	...	Holmes (1892 III.).
			July	...	Tempel (1873 II.).

OBSERVATIONS OF MARS AT MEUDON.—M. Perrotin, whose observations of Mars are very well known, commenced at Meudon, in December of last year, a series of observations of that planet. The instrument he used had a diameter of 0·83 metres, and he has been able to make some very interesting observations, which have been communicated to the *Comptes rendus* for February 15. A careful survey of the planet has led him to state that the disc is apparently divided, as regards general aspect and colour, into four zones lying parallel to the equator. Two of these comprise the equatorial regions. Further, he has noticed that at equal distances from the centre of the disc the surface details do not appear with equal facility in the four zones. The canals are always most distinct towards the middle of the disc, and they are visible for a further distance along a meridian than along a parallel. M. Janssen remarks, with regard to the latter point, that the observations show that the atmosphere of Mars contains bodies capable of condensing, and thereby of increasing the transparency of the atmosphere, as the polar regions are approached, which is in accordance with observations of the water vapour in the atmosphere of the earth. We may mention that the above observations are of special interest, since M. Perrotin is observing with a different instrument from that with which he has made all his previous observations.

THE EMBRYOLOGY OF THE NAUTILUS.[1]

NAUTILUS macromphalus is the species of nautilus characteristic of the New Caledonian Archipelago, which comprises the islands of New Caledonia, the Isle of Pines, and the Loyalty Group. I took up my residence on the shores of Sandal Bay, Lifu, in August 1896. Having collected a number of nautilus, I placed them in captivity in a large native fish-trap, specially fitted up, fed them twice or three times a week with fish, land-crabs, Palinurus, and Scyllarus, and on December 5, 1896, commenced to obtain the fertilised ova.

It is not necessary at present to describe the details of manipulation, and I therefore proceed at once to give a brief account of the more obvious features of the eggs as illustrated by the accompanying figures. The eggs are laid singly and at night, in concealed situations, and are firmly attached by a sponge-like reticulate area of attachment placed towards their hinder inflated extremity, usually on one face of the egg-case, but sometimes quite posteriorly to a suitable surface. I supplied the latter to the nautilus by fixing pieces of old sacking to the walls of the fish-basket, leaving loose, overhanging folds, beneath which the eggs could be well concealed. The fibres of the sacking were deftly employed by the nautilus in cementing their eggs.

The ovum is enclosed within a double casing, an inner closed capsule, and an outer capsule more or less freely open in front. The material of which the capsules consist is of a bright milk-white colour, and of firm cartilaginoid consistency. The capsules do not collapse, but retain their shape when allowed to dry.

For convenience of description, the exposed surface of the egg may be spoken of as the dorsal or upper side, while the

FIG. 1.—Fertilised egg of *Nautilus macromphalus* in the natural attached position. The pectinate ridges and fenestrations, together with the slit in the wall of the outer capsule, are well seen. The arcuate thickening in the middle of the posterior half of the egg is due to the fusion of the outer with the inner capsule. In this ovum the anterior membranous prolongations of the outer capsule were unequal, the larger of them having the form of a thin flattened expansion.

attached side may be referred to as the lower or ventral side. The outer capsule is separate from the inner capsule below and for about two-thirds of the upper side, but is fused with it in the postero-dorsal region. Where the two capsules are fused together the covering of the ovum is much thickened.

The egg with outer covering complete is of remarkably large size, attaining a length of 45 mm., everything included, with a width of 16 mm., and a maximum height of 16·25 mm. The length and the width are fairly constant in normally shaped eggs, but the height varies somewhat, some eggs being a good deal flatter than others.

In Fig. 1 an egg is represented as seen in its usual natural attached position. The depressed or "anterior" end of the egg is, as a rule, directed vertically upwards. The outer capsule is continued in front into two thin, translucent, terminal processes. For nearly half the length of the egg on the upper side the two halves of the outer capsules are separated by a narrow slit from one another and join together behind the centre of the egg. The dorsal ridge or suture of the inner capsule can be seen through this slit in the outer capsule. On the lower side of the egg the two halves of the outer capsule are continuous across the middle line throughout the length of the egg, except at the extreme anterior end.

The surface of the egg in the posterior inflated region is smooth, with a few slight folds like the folds of drapery, giving it a graceful appearance. The anterior depressed region is characterised by the presence of a number of pectinate ridges and of fenestrations in the wall of the outer capsule (Figs. 1-3).

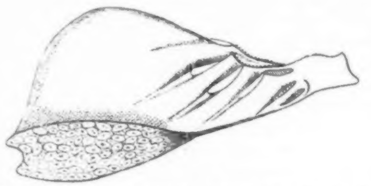

FIG. 2.—The same egg from the side, showing the inflated posterior or proximal portion and the more flattened distal portion, as also the spongy area of attachment.

Sometimes, however, the pectinations are obscure and the fenestrations may be absent.

Hardly will any two eggs present an exactly similar appearance. Sometimes there are shred-like processes from the surface of the outer capsule, lending a more or less tattered appearance to the egg.

In Fig. 4 another egg is shown with the above-described slit in the upper wall of the outer capsule, widened out so as to disclose the inner capsule to view.

The inner capsule has a regular oval shape with anterior pointed extremity and a generally smooth surface. Its wall has a finely striated structure, the striæ having a watery appearance. There are three distinct seams or sutures, representing lines of least resistance, in the wall of the inner capsule, namely, a median suture on the upper side (*i.e.* the side directed away from the attached side of the egg), and two lateral sutures placed towards the lower surface of the capsule (Figs. 4-6).

The dorsal suture is marked by a prominent ridge which is produced in front beyond the anterior extremity of the main body of the inner capsule into a slender terminal appendix.

The lateral sutures are marked by less prominent ridges, and

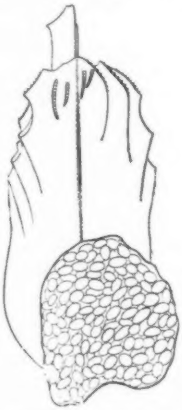

FIG. 3.—The same egg as in the preceding figures, from below. Behind is the somewhat irregularly shaped spongy area of attachment.

are continued into one another anteriorly, immediately behind the anterior extremity of the inner capsule. In consequence of the continuity of the lateral sutures, the lower side of the egg can be raised up like a cap or an operculum. The inner capsule is often easily ruptured along the sutures. In the middle line of the lower surface of the inner capsule there is a slight longitudinal groove, and other unimportant grooves often occur. Where the outer capsule is united to the inner capsule there is usually a depression or flattening in the wall of the latter.

[1] "The Oviposition of *Nautilus macromphalus*." By Arthur Willey, D.Sc., Balfour Student of the University of Cambridge. Communicated by Alfred Newton, F.R.S., on behalf of the Managers of the Balfour Fund. Received at the Royal Society February 3. Read February 11, 1897.

The vitellus (Fig. 6) does not fill the entire cavity of the inner capsule, but is surmounted by a layer of colourless, somewhat cloudy, viscid albumen which is massed up, as it were, at the two extremities of the egg. The yolk is of a rich brown colour, of very fluid consistency, and sub-translucent. The surface of

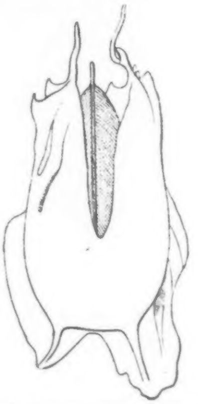

FIG 4.—Another egg of *N. macromphalus*, seen from above, with the longitudinal slit in the upper wall of the outer capsule widened out so as to expose the inner capsule to view.

the vitellus is quite smooth. The length of the inner capsule is about 26 mm., while that of the enclosed vitellus is 17 mm.

I am not in a position to say much about the embryonic area at present, but I have observed an area pellucida about the

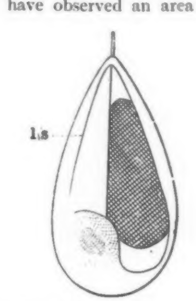

FIG. 5.—Inner capsule of another egg to show the dorsal ridge along the dorsal suture (*d s*) with its anterior terminal prolongation, and the lateral suture (*l s*). *o c*, remains of outer capsule.

middle of the lower surface of the vitellus in an egg which had been allowed to develop for twenty-four hours after being first seen. The large quantity of yolk points to the occurrence of a long period of incubation.

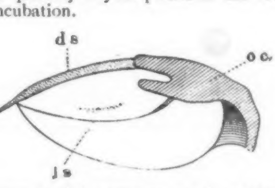

FIG. 6.—The inner capsule of the same egg, seen from below (*i.e.* from the side directed towards the surface of attachment). Half the lower wall of the capsule has been removed by slitting along one of the lateral sutures, and along the median groove (mentioned in the text), to show the brown-coloured vitellus lying in the capsule. The continuity of the lateral sutures in front is well seen. The shaded area represents a depression which occurred in the wall of the inner capsule in the region of the area of attachment of the outer capsule.

Sometimes the capsules of the egg are malformed, and, on opening such an egg, the vitellus is found to be already ruptured.

From the fact that in New Britain I obtained mature males of *Nautilus pompilius*, carrying a spermatophore in the cephalic region throughout the year, I came to the conclusion that the reproduction of nautilus took place all the year round. It now seems probable that the breeding of nautilus, as of so many other forms, is subject to a definite law of periodicity.

Finally, it may be mentioned that *N. macromphalus* varies with regard to the position of the spadix on the right or left side, and also as to the origin of the siphuncular artery, in the same way as *N. pompilius* does. The male of *N. macromphalus* carries a spermatophore in the same position as in *N. pompilius*; and, in fact, the only essential difference between the two species that I know of at present, is the difference between the shells in the umbilical region.

SIXTY YEARS OF SUBMARINE TELEGRAPHY.

SIXTY years in sixty minutes—for thus Prof. Ayrton opened the lecture which he gave on Monday, the 15th inst., at the Imperial Institute. The undertaking seemed arduous, but, in reality, only the pioneer cables were dealt with, since later submarine telegraphy has no nistory—"Happy is the cable that has no history."

Another difficulty lay in the character of the audience; some were there knowing practically everything about telegraphy, while others were absolutely unfamiliar with the whole subject, except as regards the modern sixpenny wire. Prof. Ayrton, however, by a happy mixture of mathematics and magic lantern, electricity and elocution, seemed to entirely satisfy all classes among his audience.

The lecture opened with a letter of W. F. Cooke's, written in February 1837, in which he mentioned having seen Wheatstone—"a music seller in Conduit-street, but an extraordinary fellow." This acquaintance speedily ripened, for in the same year a partnership was formed between these two men, and the first telegraph line was constructed in this country; they also began to consider the possibility of laying an insulated wire under water.

The actual date of the commencement of subaqueous telegraphy seems, however, to be rather uncertain. Baron Schilling is said to have exploded mines under the Neva by means of an electric current as early as 1812, while it is certain that Colonel Pasley used this method to blow up the wreck of the *Royal George* at Spithead in 1838. But, as Prof. Ayrton pointed out, "it is to Morse that we can with certainty give the credit of having first used a wire under water insulated with india-rubber."

In 1842 this celebrated American inventor, then struggling in most dire poverty, laid with his own hands two miles of india-rubber coated wire between Castle Garden and Governor's Island. In the morning he found his cable broken, but not before he had successfully sent a series of the first subaqueous telegraphic messages.

It was not until after the introduction of gutta-percha into this country that submarine telegraphy became of practical importance. Sir Wm. Siemens first recommended the use of this "wonderful stuff" for insulation purposes, and in 1847 the firm of Siemens and Haske began to coat wires with gutta-percha, by means of a machine on the macaroni principle. Shortly afterwards such cables were laid in the harbour at Kiel and in the Hudson.

The history of submarine telegraphy, from a commercial standpoint, may be said to commence in June 1845, when Jacob Brett registered the General Oceanic Telegraph Company "to form a connecting mode of communication by telegraphic means from the British Islands across the Atlantic Ocean to Nova Scotia and the Canadas, the Colonies, and Continental Kingdoms"—certainly a bold project in those early days. As indicating the electric conditions of those times, the lecturer here quoted an extract from the *Weekly Register*, describing the transmission of the Queen's speech from London to Newcastle in 1847. "The speech was sent by special engine to Rugby, and thence by electric telegraph . . . so that the time occupied in its transmission was the *incredibly* short period of 6½ hours." Certainly, our modern minds do have some difficulty in crediting the time taken in transmission, but it is not due to its amazing shortness.

Meanwhile, Jacob Brett, together with his brother John Watkins Brett, applied to Sir Robert Peel for the purpose of obtaining a telegraphic monopoly; but the answer was unsatisfactory. Two years later the brothers petitioned again, with

greater success, for permission to lay a cable between Dover and Calais. On August 10, 1849, Louis Napoleon granted them an absolute monopoly for ten years, provided that the wire was laid by September 1, 1850. Before this date a telegraph wire under the Channel became an accomplished fact, and messages were certainly transmitted through it, although they seem to have been slightly incoherent. The glory of this telegraph was, unfortunately, short-lived, for after the first evening it maintained an obstinate reserve, and "spoke no more."

The next year another concession was granted to the Bretts by the French Government, and on the strength of this the Submarine Telegraph Company was formed. But £300 was all the public would subscribe, as it had already been conclusively proved that submarine telegraphy was an impossibility. Happily Mr. Crampton came to the rescue, while Mr. Küper suggested armouring the insulated conductor with iron sheathing—a proposal also made by Willoughby Smith. Once more England and France were electrically connected, and on November 13, 1851, the public sent a message through a submarine cable for the first time in the history of the world.

The Bretts then applied to the Government for a monopoly to electrically connect England and Ireland. Prof. Ayrton read out the original replies they received on this occasion, in which each Government department in turn complimented the brothers on their perseverance and success, but regretted that the matter did not lie in their power, and referred them "next door." The laughter that was here heard among the audience was presumably due to the striking contrast this afforded with the promptness and celerity of Government procedure of to-day?

As early as 1844 Morse had written to the American Treasury: "My experience is that telegraphic communication on the electromagnet plan might certainly be established across the Atlantic Ocean." Nothing was done in the matter until 1855, when a syndicate was formed, and in the following year Cyrus Field crossed over to England, where he signed an agreement with J. W. Brett, Charles Bright, and E. Whitehouse to start an Atlantic Telegraph Company.

Great difficulties foreshadowed the working of an Atlantic cable, due to the retardation of the signals. In connection with this subject, the lecturer stated the very different values which had been assigned by Wheatstone, Latimer Clark, and others to the velocity of electricity, before it had been deduced from a paper of Lord Kelvin's, in 1855, that electricity had no velocity in the ordinary sense of the word.

A mechanical model was shown illustrating the difference between the *sudden* opening of a door by a ball projected at it with a certain velocity, and the *gradual* opening of the door by the *gradual* increase of the pull at the other end of a long piece of india-rubber—the latter method being comparable with the action of an electric current. Experiments were also made on a water cable, and it was shown that by combining resistance and capacity, waves of water travelling in opposite directions could exist at the same time in a tube; also that if positive and negative pressures were alternately applied on one end of the tube, with an interval of time less than thirteen seconds between their application, no effect whatever could be detected at the other end of the tube, a distance of seven feet. The spots from three very dead-beat galvanometers, placed respectively at the sending, middle, and receiving end of an artificial Pacific cable, were then projected on the screen, and the gradual rise of current along the cable was made visible to every one, the current at the distant end taking six seconds to reach its steady value.

The lecturer here mentioned Fourier's *Théorie Analytique de la Chaleur*, published in 1822, which "mathematical poem," though written long before cables were dreamt of, enabled Kelvin thirty years later to attack a problem, the successful solution of which has created submarine telegraphy. For two other important conclusions were deduced from Kelvin's 1855 paper, namely, that the time elapsing before the current began to appear at the other end of a cable, only depended on the product of the resistance of the conductor into the electrostatic capacity, and practically not at all on the battery power. Also that the retardation of the signals was proportional to the square of the length. The first of these results was opposed to the opinion of such well-known engineers as Sir Charles, and Edward, Bright, who considered that the velocity of electricity varied with the use of high potential frictional, or of low potential voltaic electricity. From his own theory Kelvin calculated that the probable speed of signalling through the proposed Atlantic cable would be at the rate of three words a minute, which was subsequently found to be obtainable with his mirror galvanometer. Siemens, however, feared that only one word a minute could be sent, while Charles Bright, from experiments on 2000 miles of underground conductor, predicted ten or twelve.

Meanwhile the Atlantic Telegraph Company had been successful in their efforts, for in 1857 the U.S. frigate *Niagara* and H.M.S. *Agamemnon* started from Valentia with 2500 miles of cable coiled in their holds. About a tenth part of this was payed out, and then the wire broke in deep water; and so ended the first attempt to lay an Atlantic cable. The following year a second expedition started, and after several failures this cable was successfully laid, and England first spoke electrically to America. The life of this cable was, however, pitifully short; the signals grew weaker and weaker, and after one little month it died. It was not, indeed, until 1866 that a complete cable was laid by the Telegraph Construction and Maintenance Company, which also in the same year captured a cable that had been previously broken and lost. Thus two good cables were completed between England and America.

Prof. Ayrton then described the siphon recorder in some detail, and exhibited the earliest example of that instrument, constructed in 1870. Later forms were also shown, in which the electrified ink was replaced by the use of a vibrating siphon. The system of automatic sending was explained, and the question of signalling briefly considered, diagrams being thrown on the screen illustrative of the effect of condensers and of curbing in obtaining sharp signals. The word "imperial" was sent by an automatic sender at the rate of seventy-two letters a minute through the artificial Pacific cable in four different ways: (1) with no curbing nor condensers at either end; (2) with curbing only; (3) with condensers only; (4) with curbing and condensers at both ends of the cable.

Before concluding his lecture, Prof. Ayrton, not content with having his subject limited to the space of sixty years, looked ahead and saw, or rather failed to see, the cables of the future. For it is his belief that in the days to come copper conductors, gutta-percha insulation, and iron wire sheathing will be relegated to the museum of antiquity, and when a person wishes to telegraph to a friend, he knows not where, he will call to him in an electromagnetic voice, which will be heard distinctly by him who has the electromagnetic ear, but will be silent to every one else!

The hall was hung with the portraits of the chief of the early workers in submarine telegraphy, each in its turn being illuminated with a projector when reference was made to it; the lecture was illustrated with historical letters and documents, specimens of all the important early cables, as well as of the latest, hydraulic and other models; and an artificial cable electrically 3600 miles long, fitted up with signalling apparatus at each end, was shown through the kindness of Dr. A. Muirhead.

Mr. Preece was unfortunately absent through illness, but his place as Chairman was filled by Sir Henry Mance. Thus a compensation was afforded in having an opportunity of admiring not Mance's method of finding faults, but his method of finding merits in Prof. Ayrton's sixty years of cable.

THE VALUE OF IRRIGATION CANALS IN INDIA.

THE deplorable state of large districts in India at the present time is attracting a great deal of attention, owing to the famine which is devastating the country, caused by the failure of the crops from the drought and want of rain. Under such conditions, every drop of water is as precious as gold, and the canal authorities have to strain every nerve to make the available water supply spread as far as possible. Any information bearing on the canals cannot fail, at such a time, to be of interest. A return recently issued by the Public Works Department bears testimony not only to the great benefit that has already been conferred on India by the system of irrigation pursued during recent years by the Indian Government, but also shows that these works have been a financial success.

Lord Lansdowne is reported strongly to have urged that public works of irrigation do more good than any other form of public works; and it is a matter of regret that more has not been done in the past in the matter of canal construction. The total area irrigated in India from Government works is about $13\frac{1}{2}$ millions of acres, the estimated value of the crops raised on this area amounting to 37,000,000*l*., taking a crore of

rupees at 1,000,000*l.*, up to the end of 1895, as far as the report goes. A sum of 29½ millions of pounds had been expended on the construction of 37 works, which brought in a net revenue of 4·32 per cent. on the total capital expended, although some of the works were not then completed. Of these, the Madras canals paid 6·75 per cent.; the Sind, 6 per cent.; the North-western Provinces, 5·22 per cent.; the Punjab, 4·33 per cent.; Deccan and Goojerat, 1·18 per cent.; and Bengal, less than one-tenth per cent. The general deductions to be drawn from the figures given in the report are that, while these irrigation canals have been of inestimable value to the productive resources of India, and in mitigating the direful effects of famines, the expenditure has at the same time proved very remunerative; and that though the Bengal and Bombay canals have been unremunerative, and are never likely to pay, still the works in the other provinces have more than compensated for these losses. The results from minor works, or those constructed out of revenue, are even more satisfactory. Seventy of these works have cost about 3,000,000*l.*, and irrigate 2,194,441 acres, the net revenue yielding 12·61 per cent. on the outlay. The annual allotments for these works have in recent years been 360,000*l.*, of which about 240,000*l.* is expended on up-keep. In view of their remunerative character and immense benefit to the natives, the policy of expending large sums in relief works, and extending the system of irrigation in seasons of drought, as is now being done, must commend itself as being sound legislation. There is a third class of canals, known as "protective" works, the cost of which is charged to the funds set apart for protection from, or the mitigation of, famines. These have cost about 2,000,000*l.* They are principally designed to provide against seasons of drought. Up to the present they have only brought in a return of 1 per cent. on the outlay. They cannot, however, be looked at from a commercial standpoint, but rather on their value in years of drought; whereas the year to which the return relates was one of considerable rainfall. If, during the present season of drought, they have aided in mitigating the effect that otherwise would have followed in the districts where they are situated, they will have accomplished the object for which they were constructed, although they may not prove commercially productive.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. W. F. Sedgwick, bracketed Senior Wrangler, 1894, has been elected to an Isaac Newton Studentship in Astronomy.

The General Board of Studies has published the proposed regulations for the admission of Advanced Students to certain Triposes. In general the standard to be required from such students is that of a second class in Part ii. of the Tripos. In Natural Sciences a first class in a single subject of Part ii. will be expected.

The Board of Supervision for Indian Civil Service students is about to be formally constituted a Special Board of Studies, with the same status and privileges as the other Special Boards.

Honorary degrees are to be conferred, at the congregation on March 11, on the French Ambassador (Baron de Courcel) and the American Ambassador (Mr. Bayard), and also on Dr. Zahn of Berlin, and Prof. Klein of Göttingen. Dr. Nansen cannot attend on that day, and will accordingly be admitted on March 16.

The following have been appointed Electors to the respective professorships mentioned. Plumian of Astronomy, Prof. H. H. Turner; Anatomy, Sir W. H. Flower; Downing of Medicine; Dr. S. Ringer; Cavendish of Physics, Prof. A. W. Rücker; Mechanism and Applied Mechanics, Sir F. J. Bramwell; Surgery, Prof. Allbutt; Pathology, Dr. D. MacAlister.

THE Hartley College, Southampton, has received a valuable addition to its library in the form of a complete series of the "*Challenger* Reports," presented by the Government at the representation of the Royal Society.

AT a meeting of the London County Council on Tuesday, the recommendation of the Technical Education Board, asking the Council for the sum of £150,000 from the Customs and Excise dues, for the purpose of technical education in London during the year 1897–98, was agreed to.

AT the last meeting of the Council of Bedford College, London, the following resolution was passed unanimously: "That the Council and Teaching Staff of Bedford College, London, express the earnest hope that Her Majesty's Government will at an early date again introduce a Bill for the creation of a Statutory Commission for the reconstitution of the University of London on the lines indicated by Lord Cowper's Commission, and assure the Government that such a measure will have their active support."

Science announces the following gifts to education in the United States:—The will of the late Mrs. Horatio Lyon, of Springfield, Mass., gives, among other public bequests, 10,000 dols. to Monson Academy, 10,000 dols. to Pomona College, and 10,000 dols. to Menden Free Library.—Harvard University has received from Mr. J. Howard Nichols 5000 dols. to be used to found a new scholarship, preference being given to a student from the State of Alabama.—The will of the late Charles Willard, of Battle Creek, Mich., leaves 40,000 dols. to the Baptist College at Kalamazoo, Mich., and 40,000 dols. for a library building for the city schools at Battle Creek, Mich.

WE are glad to see that the University colleges are to be given an additional grant by the Government. The increase was announced in the House of Commons on Monday, when Sir W. Houldsworth (Manchester, N.W.) asked the Chancellor of the Exchequer whether any report had yet been received from the Commissioners appointed by him to visit the University colleges which received a Government grant, and, if so, whether there was any prospect of these colleges, or any of them, receiving an augmented grant in the next financial year. The Chancellor of the Exchequer replied to the first question in the affirmative, and he pointed out that an additional grant of £9500 for the University Colleges appears in the Civil Service Estimates.

THE *Journal of School Geography*, the first number of which has just been published at Lancaster, Pennsylvania, U.S.A., should be a real source of help and a valuable geographical aid to teachers in elementary and secondary schools. The aim of the new periodical is to present the newest and best geographical information in such a form that it can be readily used for teaching purposes. The responsible editor is Prof. Richard E. Dodge, Teachers' College, New York City, and associated with him are Prof. W. M. Davis, Mr. C. W. Hayes, Prof. H. B. Kummel, Dean McMurry, and Mr. R. de C. Ward. Natural science, physical geography, geology, physiography, pedagogy, and climatology are thus all represented upon the editorial staff, so that attention to all the phases of the broad science of geography is ensured. The new journal should be of great assistance in advancing geographical knowledge, and in making the study of the earth a means of developing the habit of observation.

THE following are among recent appointments:—Prof. Francis E. Lloyd to be professor of biology in the Teachers' College, New York; Dr. Alexander P. Anderson to be professor of botany at Clemson College, S.C.; Postmaster-General Mr. L. Wilson to be president of the Washington and Lee University at Lexington, Kentucky; Dr. Chr. Nussbaum to be professor of hygiene in the Technical High School at Hanover; Dr E. Wiechert, privat-docent in mathematical physics at Königsberg, to be titular professor; Dr. J. Liznar to be professor of meteorology at Vienna; Hon. James Wilson, director of the Iowa Agricultural Station and professor of agriculture in the Iowa Agricultural College, to be Secretary of Agriculture in the United States; Dr. L. A. Bauer to be assistant professor of mathematics and mathematical physics in the University of Cincinnati; Dr. L. F. Barker to be assistant professor of anatomy in the Johns Hopkins University (Baltimore).

IN a valuable and well-considered report upon the work accomplished last year, under the auspices of the Technical Education Committee of the Derbyshire County Council, Mr. Percy Hawkridge shows that in his county a very great development of classes for industrial students has taken place since the advent of the County Council into the educational field. In 1890–91 there were 700 students attending elementary science classes in Derbyshire; in 1891–92, when the County Council education scheme came into force, there were 1325 students; and in 1894–95 the number was 2342. This great development has taken place although classes not connected with local

industries have been almost entirely weeded out, and in spite of the raising of the standard in the Government examinations. It is worth noticing that prior to 1891, not more than 20 students attended mining classes, although there are over 150,000 people dependent on this industry. There are now close upon 600 such students. Mr. Hawkridge also points out that in 1891, after the Science and Art Department had been in existence for over 25 years, less than 100 pupils of secondary schools in Derbyshire were receiving instruction in science, which instruction was wholly theoretical in character. There are now 500 pupils under scientific instruction *in properly equipped class-rooms and laboratories*. This is a point the importance of which it is almost impossible to over-estimate. The facts are held to indicate that local authorities, being more intimately in touch with local needs and circumstances than any central body, are better able to develop educational work in the right direction. Mr. Hawkridge hopes, therefore, that so far as secondary and technical education are concerned, future legislation and future administrative changes may tend to place the details of local management more completely and unreservedly in the hands of responsible and representative local authorities.

SCIENTIFIC SERIALS.

IN a continuation of the important paper, in the *Journal of Botany* for January, on Welwitsch's African Freshwater Algæ, W. and G. S. West describe no less than three new genera—*Psephotaxus*, belonging to the Ulotrichaceæ; *Temmogametum*, the type of a new family of Conjugatæ; and *Pyxispora*, belonging to the Zygnemaceæ.

THE number of the *Nuovo Giornale Botanico Italiano* for January contains the commencement of a *Prodromus* of the mosses of Bolivia, by Sig. K. Müller; an account of the ferns and fern-allies collected by Father Giraldi in China, by Sigg. Baroni and Christ; and a description, by Sig. Massolongo, of the galls produced on *Stipa pennata* by *Tarsonemus Canestrinii*.

IN a batch of the *Bullettino* of the Italian Botanical Society, which has just reached us (October 1896 to January 1897), are a very large number of papers of special interest to Italian botanists. In addition, Sig. A. Jatta discusses at length Minks's theory of symbiosis in lichens. While admitting the importance of the facts brought forward by Minks, he does not consider that these militate against the theory of the parasitism of lichens. Prof. L. Macchiati describes the microbe which produces flaccidity in silkworms. Prof. Arcangeli discusses the cause of the presence or absence of the black spots on the leaves of *Arum italicum*, which may be connected with the attraction of insects for the purpose of fertilisation. Prof. Macchiati has a further note on the vexed question of the endosperm in the seeds of *Vicia narbonensis*.

American Journal of Science, February.—Outlines of a natural classification of the Trilobites, by C. E. Beecher. The present state of knowledge of their structure and development is in favour of giving the trilobites the rank of a sub-class, but for purposes of comparison and correlation the fullest results can be brought out by recognising the old and well-known sub-classes, the Entomostraca and Malacostraca. This gives three divisions of Crustacea, and the trilobites agree closely with the theoretical crustacean ancestors of the other sub-classes. The author gives a complete diagnosis of the Trilobita, and intends in a subsequent paper to give a classification based upon their ontogeny.—Preliminary trial of an interferential induction balance, by C. Barus. The slender iron cores of two identical helices are placed at right angles to each other in a horizontal plane, and at the same distance from their point of convergence. The distant ends are rigidly fastened, and the fore ends are provided with small plane mirrors. The latter form part of a Michelson refractometer system. Interference fringes may be produced when the apparatus is at rest, or the two mirrors vibrate in an identical manner. They vanish when the plane is displaced. This apparatus is capable of many useful applications to alternating currents and magnetic induction.—The multiple spectra of gases, by J. Trowbridge and T. W. Richards. The difference between the red spectrum of argon obtained with a steady current from a high-potential accumulator and the blue spectrum obtained by means of undamped oscillations has its counterpart in nearly all the other elementary gases. The fluted spectrum of nitrogen is obtained by the steady discharge, and the line spectrum by the condenser. Hydrogen in the former case gives a band spectrum resolvable into sharp lines. Similar differences are observed in the spectra of the halogens. They may, however, be simply due to a change of temperature. Further experiments are being made to decide this point.—Nocturnal protective colourations in animals as developed by natural selection, by A. E. Verrill (will be printed in full).—The Stylinodontia, a sub-order of Eocene Edentates, by O. C. Marsh.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 4.—"The Gaseous Constituents of certain Mineral Substances and Natural Waters." By William Ramsay, F.R.S., and Morris W. Travers, B.Sc.

Helium was found to be present in the gases evolved on heating fergusonite, monazite, samarskite, columbite, and pitchblende.

In malacone (a specimen from Hitterö, collected by one of the authors) both argon and helium were found. This is remarkable as being the only case of a mineral yielding argon. The result was twice confirmed.

The following minerals gave carbon monoxide:—Cinnabar and cryolite.

The following gave a mixture of hydrogen and carbon monoxide:—Apatite; also blue clay from the Kimberley diamond-fields.

The following gave hydrogen alone:—Serpentine, gneiss.

The following gave no gas:—Baryta, celestine, and scapolite.

Five meteorites were examined; only hydrogen was evolved. A previously examined specimen gave both argon and helium.

The sulphur wells of of Harrogate and of Strathpeffer gave argon but no helium.

The mineral waters of Cauterets, Pyrenees, gave both argon and helium. The spectra of these samples of gas were carefully examined in the hope of finding evidence of some new substance, but without result. If a new substance is present, it cannot exist in measurable quantity in any of the samples examined.

February 11.—"The Artificial Insemination of Mammals and subsequent possible Fertilisation or Impregnation of their Ova." By Walter Heape, M.A., Trinity College, Cambridge. Received January 15.

Chemical Society, February 4.—Mr. A. G. Vernon Harcourt, President, in the chair.—The following papers were read:—Observations upon the oxidation of nitrogen gas, by Lord Rayleigh. It is doubtful whether Davy's statements respecting the oxidation of dissolved nitrogen in water during electrolysis are correct. A detailed account is given of the apparatus used in oxidising nitrogen by an electric arc; the apparatus causes 21 litres of the mixed gases to combine per hour at an expenditure of 1 horse-power. The influence of pressure upon the oxidation of nitrogen was also studied.—On some apparatus for steam-distillation, by F. E. Matthews.—Researches in the stilbene series, I., by J. J. Sudborough. Small quantities of benzil are formed on heating benzoïn with acetic acid. Deoxybenzoïn is converted into a solid chlorostilbene by phosphorus pentachloride; similarly methyl- and ethyl-deoxybenzoïn yields methyl- and ethyl-chlorostilbene. Diortho-substituted benzoic acids. III. Hydrolysis of substituted benzamides, by J. J. Sudborough, P. G. Jackson, and L. L. Lloyd. In order to determine whether diortho-substituted benzamides exhibit a similar degree of stability towards hydrolysing agents as do the diortho-benzoyl chlorides, a number of substituted benzamides have been examined.—Conversion of campheroxime into methylcamphorimine and camphenylnitramine, by M. O. Forster. The base which the author has obtained by heating camphoroxime with methylic iodide is methylcamphorimine,

$$C_8H_{14}\langle\begin{matrix}CH_2\\ |\\ C:NMe.\end{matrix}$$

—Note on Wechsler's method for the separation of fatty acids, by A. W. Crossley. The author finds that Wechsler's process for separating fatty acids by partially neutralising and steam distilling the mixture is unsatisfactory.—On the crystalline structure of gold and platinum nuggets and gold ingots, by A. Liversidge. The author suggests, as the result of experiment, that the gold in nuggets has been slowly deposited from solution,

the nuggets being more or less rolled masses of gold which have been set free from disintegrated veins.—On the presence of gold in natural saline deposits and marine plants, by A. Liversidge. Rock salt, sylvine, and other similar saline deposits, bittern, seaweed, kelp, oyster-shells, &c., have been examined for gold; the natural salts contained from 1 to 2 grains of gold per ton, whilst kelp and bittern furnished up to 20 grains of gold per ton.

Geological Society, February 3.—Dr. Henry Hicks, F.R.S., President, in the chair.—The subgenera *Petalograptus* and *Cephalograptus*, by Miss G. L. Elles. The forms referred to in the paper are accepted as subgenera of *Diplograptus*, as defined by Lapworth. The two subgenera have frequently been much confused, but examination of specimens preserved in relief shows that they have very distinctive characters, especially at the proximal ends. The author gave diagnoses of the two subgenera, and detailed descriptions of certain forms.—On some superficial deposits in Cutch, by the Rev. J. F. Blake. The author arranges the deposits of which he treats under the following heads: (1) Sub-recent Concrete; (2) Boulder Beds associated with the former; (3) Quartzite Reefs; (4) Infratrappean Grits; (5) Laterite; (6) Alluvium and Rânn. In the discussion which followed, Dr. W. T. Blanford expressed his satisfaction that some of the peculiar formations of Western India had been examined by an English geologist of experience.

Mathematical Society, February 11.—Prof. Elliott, F.R.S., President, in the chair.—Mr. F. S. Macaulay read a paper on a theorem in non-Euclidean geometry. An animated discussion followed, in which the President, Mr. Kempe, F.R.S., Mr. Love, F.R.S., and Lieut.-Colonel Cunningham, R.E., joined with the author.—Mr. Kempe made an impromptu communication on Prof. Sylvester's partition theorem, and the President and Major MacMahon, R.A., F.R.S., also spoke on the subject. The President (Major MacMahon, Vice-President, in the chair) gave a short account of Mr. Segar's theorem, that the product of the differences of n unequal numbers is divisible by the products of the differences of $0, 1, 2, 3, \ldots (n-1)$, and showed, also, that the product of the differences of n unequal square numbers is divisible by the product of the differences of $0^2, 1^2, 2^2, 3^2, \ldots (n-1)^2$.—Lieut.-Colonel Cunningham brought forward some high primes. They were forty-three in number, the highest being 25,621,901, and the lowest 9,170,881.—A paper by Mr. H. M. Taylor, on the degeneration of a cubic curve, was communicated by reading its title.

Zoological Society, February 16.—Prof. George B. Howes in the chair.—Dr. E. C. Stirling, F.R.S., exhibited some bones, casts, and photographs of the large extinct struthious bird from the *Diprotodon*-beds at Lake Callabonna, South Australia, which had been recently discovered and named by him *Genyornis newtoni*, and gave a history of the principal facts connected with its discovery.—Mr. G. E. H. Barrett-Hamilton exhibited a pair of Walrus-tusks from the Pacific, belonging to the species which has been named *Trichechus obesus*, and gave some account of the Cetaceans and Seals of the North Pacific.—Mr. A. Smith Woodward read a description of *Echidnocephalus troscheli*, an extinct fish from the Upper Cretaceous of Westphalia, proving its identity in all essential respects with the existing deep-sea genus *Halosaurus*.—Mr. G. A. Boulenger, F.R.S., read a note on *Acanthocybium solandri*, which recorded the occurrence of this fish in the Arabian Sea. A specimen of it, transmitted by Surgeon Lieut.-Colonel Jayakar, from Muscat, had recently been received by the British Museum, in which the species had been previously represented only by a dried head from the Atlantic.—Mr. W. E. de Winton made some remarks on the distribution of the Giraffe, and gave the synonyms and more definite descriptions of the two existing forms. *Giraffa camelopardalis*, Linn., was fixed for the name of the three-horned northern form, and *G. capensis*, Less., for that of the two-horned southern species.—A communication was read from Dr. Alfred Dugès containing a description of a new Ophidian from Mexico, which was proposed to be named *Oreophis boulengeri*. gen. et sp. nov.—A communication was read from Mr. C. Davies Sherborn, containing a list of the exact dates of the publication of the parts of the natural history portion of Savigny's "Description de l'Egypte."—Mr. F. E. Beddard, F.R.S., read a paper on the anatomy of the Tropic-bird (*Phaëthon*) of the order Steganopodes, amongst which he considered it to occupy a low position near *Fregata*.

Royal Meteorological Society, February 17.—Mr. Edward Mawley, President, read a report on the phenological observations during the past year.—The Hon. Rollo Russell gave the results of some observations on haze and transparency which he had made at Haslemere, in Surrey. From these it appears that the clearest hours, at a good distance from towns, are from about noon to 3 p.m. The clearest winds are from S. to N.W. inclusive, and especially W.S.W., W., and W.N.W.; the haziest are those between N. and E. On bright mornings with a gentle breeze or calm, from autumn to spring, the haze or fog which has lain on the low ground frequently covers the hills in the course of its ascent a few hours after sunrise. At any distance within 100 miles of London, or of the Black Country, observations requiring clear views are likely to be interfered with when the wind blows from their direction, and should, therefore, be taken early.

PARIS.

Academy of Sciences, February 15.—M. A. Chatin in the chair.—The election of M. Sebert in the Section of Mechanics was confirmed by the President of the Republic.—Notice on the life and works of General Favé, by M. Sarrou.—Note on the third part of the "Catalogue of the Paris Observatory," by M. Lœwy.—The age of copper in Chaldea, by M. Berthelot. The analysis of a spear, carrying drawings and inscriptions, and at least 4000 years old, showed that the metal was nearly pure copper, neither tin, lead, arsenic, nor antimony being present in appreciable quantities. The oxidised portion was nearly pure atakamite, $3CuO.CuCl_2 + 4H_2O$. The description of these and similar objects as bronze is thus shown to be erroneous. Copper appears to have preceded bronze in the manufacture of tools.—Studies on the methods of manufacturing wine in the southern regions, by M. A. Muntz. If the temperature during fermentation is allowed to rise to 40° or thereabouts, as will frequently be the case in the southern districts, the yeast is killed, fermentation is stopped, and the conditions are then favourable for the growth of bacteria prejudicial to the wine. At the same time considerable quantities of ammonia salts are produced. These ill-effects can be prevented by artificial cooling with water, in an apparatus nearly identical with that used for cooling beer worts. The most favourable temperature at which to commence cooling is about 34°.—On certain points in the theory of residues of powers. Distinctive characters of numbers or roots from which arise generating residues, by M. de Jonquières.—On the planet Mars, by M. Perrotin. An account of observations on Mars made chiefly during December last, with the large equatorial at the Observatory of Meudon (see p. 401)—Remarks on the preceding note, by M. J. Janssen.—Description of some air barometers, allowing of the measurement of atmospheric pressure with a higher accuracy than with the mercury barometer, by M. V. Ducla. A description of a navigable aerostat, by M. Dheutte.—On operations in general, by M. C. Bourlet.—On a series of primitive groups, isomorphic holohedrically to multiple transitive groups, by M. Ed. Maillet.—On a safe receiver for containing liquefied gases, by M. J. Fournier.—A self-recording apparatus for measuring the movements of the pendulum, by MM. Jean and Louis Lecarme.—Changes of colour in flashes of light of short duration, by M. Aug. Charpentier. For short periods, other things being equal, the less refrangible colours are the first seen. When the intensity diminishes the more refrangible colours predominate, according to the law of Purkinje.—On the influence of the Röntgen rays upon the explosive distance of the electric spark, by M. Guggenheimer. The experiments showed that keeping the sparking distance and potential difference constant, the increase of the explosive distance depends upon the intensity of the Röntgen rays falling upon the spark gap. If the potential and intensity of the rays were kept constant, the increase of the explosive distance depends upon the distance of the spark gap from the emissive wall of the tube.—On the false equilibrium of hydrogen selenide, by M. H. Pelabon.—Action of cuprous oxide upon solutions of silver nitrate, by M. Paul Sabatier. The silver is removed from solution, a greyish deposit being formed, which, upon a careful examination, was found to consist of a mixture of metallic silver and basic copper nitrate.—Action of the oxides of nitrogen upon ferrous chloride and bromide, by M. V. Thomas.—On some derivatives of salicylic aldehyde, by M. Paul Rivals.—On a vegetable lipase extracted from *Penicillium glaucum*, by M. E. Gérard. Cultures of this mould have the property of saponifying monobutyrin,

nd hence contain a ferment either identical or closely analogous to the lipase of M. Hanriot. — Influence of diet and starvation on the effects of certain microbial toxines, by MM. J. Teissier and L. Guinard. The effects of the toxines of diphtheria and pneumobacilline are considerably modified by the absence of nourishment. The experiments have not yet been sufficient to warrant general conclusions, but the tendency of those described has been to show that the lesions produced by the toxines are much less severe in the absence of food.—New observations on the Lepidoptera harmful to maize and sugar-cane. The autumn-winter generations of *Sesamia monogrioides*, Lefèvre, by M. J. Kunckel d'Herculais.—Morphology of the appendices of the anterior extremity of the middle intestine of the Orthoptera, by M. L. Bordas.—Phenomena of autotomy in *Monandroptera* and *Raphiderus*, by M. Edmond Bordage.—On the Diatoms contained in the calcium phosphate deposits in the south of Tunis, by M. J. Tempère.—Lithological analysis of the sea-bottom in the Bay of Biscay, by M. J. Thoulet.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 25.

ROYAL SOCIETY, at 4.30.—Note on the Dielectric Constant of Ice and Alcohol at very Low Temperatures: Prof. Dewar, F.R.S., and Prof. Fleming, F.R.S.—On the Relation between Magnetic Stress and Magnetic Deformation in Nickel: Dr. E. T. Jones.—On the Relations between the Cerebellar and other Centres (namely, Cerebral and Spinal), with especial reference to the Action of Antagonistic Muscles (Preliminary Account): Dr. Max Löwenthal and Prof. Horsley, F.R.S.—On the Action of Light on Diastase, and its Biological Significance: Prof J. R. Green, F.R.S.—Fragmentation in *Lineus gesserensis*: A. Brown.
ROYAL INSTITUTION, at 3.—The Problems of Arctic Geology: Dr. J. W. Gregory.
SOCIETY OF ARTS, at 8.—The Mechanical Production of Cold: Prof. James A. Ewing, F.R.S.
INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Electric Interlocking the Block and Mechanical Signals on Railways: Reply of F. T. Hollins to the Discussion.—Relative Size, Weight, and Price of Dynamo-electric Machines: E. Wilson.
SANITARY INSTITUTE, at 8.—Sanitary Laws and Regulations governing the Metropolis: A. Wynter Blyth.
CAMERA CLUB, at 8.15.—Silchester, the Result of Recent Explorations: H. Jones.

FRIDAY, FEBRUARY 26.

ROYAL INSTITUTION, at 9.—Palestine Exploration: Lieut.-Colonel C. R. Conder.
PHYSICAL SOCIETY, at 5.—On the Photography of Ripples: J. H. Vincent.
INSTITUTION OF CIVIL ENGINEERS, at 8.—Rockers and Expansion-Bearings as applied to Girders of Short Span: A. F. Baynham and F. B. H. Debree.

SATURDAY, FEBRUARY 27.

ROYAL INSTITUTION, at 3.—The Growth of the Mediterranean Route to the East: W Frewen Lord.
ROYAL BOTANIC SOCIETY, at 3.45.—The Desirability of establishing an Institute for Teaching Botany in the Royal Botanic Gardens: W. Martindale.

MONDAY, MARCH 1.

SOCIETY OF ARTS, at 8.—The Industrial Uses of Cellulose: C. F. Cross.
IMPERIAL INSTITUTE, at 8.30.—Ceylon, in Ancient and Modern Times: Henry W. Cave.
SOCIETY OF CHEMICAL INDUSTRY, at 8.—Relation of Colour to Quality in Malt: J. W. Lovibond.—Hehner's Bromine Tests for Oils: J. H. B. Jenkins.—Note on the Analysis of Superphosphates: J. H. Coste.
SANITARY INSTITUTE, at 8.—Nature of Nuisances: Dr. Arthur Newsholme.
VICTORIA INSTITUTE, at 4.30.—Science and Faith: Prof. MacLoskie.

TUESDAY, MARCH 2.

ROYAL INSTITUTION, at 3.—Animal Electricity: Prof. A. D. Waller, F.R.S.
SOCIETY OF ARTS, at 8.—Gesso: Matthew Webb.
ZOOLOGICAL SOCIETY, at 8.30.—The Growth of Hair upon the Human Ear, and its Testimony to the Shape, Size, and Position of the Ancestral Organ: H. M. Wallis.—Notes on a Visit to the Bird Islands, Saldahna Bay, South Africa (illustrated with Photographs from Life shown by Lime-light): Gambier Bolton.—On a Collection of Earthworms from South Africa, belonging to the Genus *Acanthodrilus*: F. E. Beddard, F.R.S.
INSTITUTION OF CIVIL ENGINEERS, at 8.—Papers to be further discussed: The Main Drainage of London: J. E. Worth and W. Santo Crimp.—The Purification of the Thames: W. J. Dibdin.
PATHOLOGICAL SOCIETY, at 8.30.
ROYAL VICTORIA HALL, at 8.30.—A Lump of Salt: Prof. Holland Crompton.

WEDNESDAY, MARCH 3.

SOCIETY OF ARTS, at 8.—English Orchards: George Gordon.
ENTOMOLOGICAL SOCIETY, at 8.—The Prothoracic Gland of *Dicranura vinula*: O. H. Latter.

THURSDAY, MARCH 4.

ROYAL SOCIETY, at 4.30.—*Probable* Papers: Experiments on the Absence of Mechanical Connection between Ether and Matter: Prof. Lodge, F.R.S.—Second Report on a Series of Specimens of the Deposits of the Nile Delta. Communicated by desire of the Delta Committee: Prof. Judd, F.R.S.—Luminosity and Photometry: Prof. J. B. Haycraft.
ROYAL INSTITUTION, at 3.—Greek History and Extant Monuments: Prof. Percy Gardner.
SOCIETY OF ARTS, at 8.—The Mechanical Production of Cold: Prof. James A. Ewing, F.R.S.
LINNEAN SOCIETY, at 8.—On a Trichoderma parasitic on *Pellia epiphylla*, Corda: W. G.-P. Ellis.—New Species of Perichæta from New Britain, &c.: Dr. W. B. Benham.
CHEMICAL SOCIETY, at 8.
SANITARY INSTITUTE, at 8.—Objects and Methods of Inspection: Dr. J. F. J. Sykes.
CAMERA CLUB, at 8.15. Captain Abney, C.B., F.R.S.

FRIDAY, MARCH 5.

ROYAL INSTITUTION, at 9.—Some Curiosities of Vision: Shelford Bidwell, F.R.S.
GEOLOGISTS' ASSOCIATION, at 8.—Some Properties of Precious Stones: Prof. Henry A. Miers, F.R.S.

SATURDAY, MARCH 6.

ROYAL INSTITUTION, at 3.—Electricity and Electrical Vibrations: Lord Rayleigh.
ESSEX FIELD CLUB, (at Buckhurst Hill), at 7.—The Post-Pliocene Non-Marine Mollusca of Essex; A. S. Kennard and B. B. Woodward.—Variation of Lepidoptera: J. W. Tutt.

BOOKS, PAMPHLET, and SERIALS RECEIVED.

BOOKS.—Life Assurance Explained: W. Schooling (Cassell).—Pheasants, their Natural History and Practical Management: W. B. Tegetmeier, 3rd edition (Cox).—New Thoughts on Current Subjects: Rev. J. A. Dewe (Stock).—Retaining Walls for Earth: Prof. M. A. Howe, 3rd edition (New York, Wiley; London, Chapman).—Principles of Mechanism: Dr. S. W. Robinson (New York, Wiley; London, Chapman).—The Mechanical Engineering of Power Plants: Prof. F. R. Hutton (New York, Wiley; London, Chapman).—Notes on Assaying: Drs. Ricketts and Miller (New York, Wiley; London, Chapman).—The Dawn of Modern Geography: C. R. Beazley (Murray).—Metals, their Properties and Treatment: Prof. A. K. Huntington and W. G. McMillan, new edition (Longmans).

PAMPHLET.—Société d'Encouragement pour l'Industrie Nationale. Annuaire 1897 (Paris).

SERIALS.—Contributions from the U.S. National Herbarium, Vol. v. No. 1 (Washington).—Proceedings of the Physical Society of London, Vol. xv. Part 2 (Taylor).—The Open Court, February (Chicago; London, Watts).—Fresenius' Quantitative Analysis, Vol. ii Part 4, translated by C. E. Groves (Churchill).—Lloyd's Natural History, Game Birds: W. R. Ogilvie-Grant, Parts 4, 5, 6. Ditto, Monkeys: Dr. H. O. Forbes, Part 6 (Lloyd).—Bulletin de l'Académie Royale des Sciences, &c., de Belgique, 1897, No. 1 (Bruxelles).—Records of the Australian Museum, Vol. iii. No. 1 (Sydney).

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